Saskatchewan
Energy and Mines

Geological Survey
Sedimentary Geology

Geology of the Middle Devonian Dawson Bay Formation in the Saskatoon Potash Mining District, Saskatchewan.

Colin E. Dunn

1982

Report 194

RECEIVED
NOV - 8 1982
LEGISLATIVE
LIBRARY

SASK LEGISLATIVE LIBRARY
NOV 23 1982
REGINA

Minister
Hon. W. Colin Thatcher

Deputy Minister
Don Moroz

Cb
b
h
b
c
h
h
5 cm

FRONTISPIECE:
Eroded Hardground

Erosion surface (hardground — 'hgd') between the Burr (beneath) and Neely Members. Seciment is microcrystalline limestone which is pale brown above the surface and grey beneath. Features present are: 1) an eroded stromatoporoid (s) with an attached coral (c); 2) crinoid ossicles (cr); 3) halite (h) plugging vuggy porosity, and forming displacive chevron crystals (ch) in the sediment which infills the burrowed surface; 4) a black rind (py), at the erosion surface, which is probably finely-disseminated pyrite; 5) burrows (b).

Member: Contact of Burr and Neely.

Location: Kennco 2 — Young 15 36 32 29 (Lsd. 15-36-32-29W2). 3534 ft (1077 m).

CONTENTS

	Page
Frontispiece	ii
List of Figures	v
List of Tables	v
List of Plates	v
Abstract	vi
Introduction	1
Scope of Study and Introductory Comments	1
Previous Work	2
Stratigraphy	3
General	3
Detailed Stratigraphy	3
Proposed Nomenclature for Members of the Dawson Bay Formation	3
Second Red Bed Member	3
Burr Member	5
Neely Member	5
Hubbard Evaporite	6
Discussion	7
Petrography	8
General	8
Mudstone of the Second Red Bed Member	8
Carbonates of the Burr Member	10
Carbonates, Sulphates and Halite of the Neely Member	13
Halite of the Hubbard Evaporite	14
Depositional History	15
Structure	17
Fractures	17
Major Solution Features	17
Trend Surface Analysis	21
Relationship of the Dawson Bay to the Potash Beds	21
Formation Fluids	23
Distribution	23
Chemistry	24
Mechanical Properties of Dawson Bay Rocks	25
Summary and Conclusions	27
Acknowledgements	28
References	29
Appendices	33
I Well Data	33
II Selected Core Descriptions	47
III Drill-Stem-Test Data	65
IV Rock Mechanics Procedures	73
V Plates	75

LIST OF FIGURES

		Page
1.	Location, Outcrop and Subcrop Map of the Dawson Bay Formation	1
2.	Cross Section showing the Relationship of the Dawson Bay Formation to the Devonian Basin of the Canadian Plains	in Pocket
3.	Isopach Map of the Dawson Bay Formation	in Pocket
4.	Stratigraphic Nomenclature, of the Middle Devonian in Saskatchewan and Manitoba	4
5.	Cross Section of Dawson Bay Stratigraphy in Central Saskatchewan	facing page 4
6.	Idealized Dawson Bay Sequence in Relationship to a Cycle of Deposition	7
7.	Northwest-Southeast Cross Section of Wells showing the Distribution of Hardgrounds in the Burr Member	11
8.	Sequence of Events Leading to the Development of a Small Cave Deposit — Noranda Neely 16 21 34 27(W2)	16
9.	Structure Contour Map — Top of the Dawson Bay Formation	in Pocket
10.	Sequence of Events Leading to the Preservation of Dawson Bay Carbonates within the Prairie Evaporite	19
11.	Computer-Plotted Structure Contour Map — Top of the Dawson Bay Formation	in Pocket
12.	Computer-Plotted Third Degree Trend Surface Residuals — Top of the Dawson Bay Formation	in Pocket
13.	Computer-Plotted Third Degree Trend Surface Residuals — Top of the Prairie Evaporite	in Pocket
14.	Halite Isopach between the Base of the Second Red Bed Member and the Top of the Patience Lake Potash Beds	in Pocket
15.	Cross Section showing Local Absence of some Potash Beds	in Pocket
16.	Distribution of Water-Bearing Dawson Bay Strata and their Relationship to Seismic Lows	in Pocket
17.	Potentiometric Surface — Dawson Bay Formation	in Pocket

LIST OF TABLES

1.	Lithologic Composition of the Dawson Bay Formation	8
2.	Mineralogy and Chemistry of the Second Red Bed Member	9
3.	Formation Water Analyses from Drill-Stem-Test Recoveries	24
4.	Rock Mechanics Data	26
5.	Summary of Rock Mechanics Tests made upon Cored Sections from the Dawson Bay Fm	25

LIST OF PLATES

Frontispiece: Eroded Hardground

Plate 1	— Ossicle of *Gasterocoma* (1), and Cored Sections to Illustrate Main Stratigraphic Contacts	76
Plate 2	— Second Red Bed Member: Dolomitic Mudstones	78
Plate 3	— Gradational Contacts Between the Second Red Bed Member and Underlying Lithologies	80
Plate 4	— Upper Second Red Bed Member: Laminated and Brecciated Dolomicrites	82
Plate 5	— Lower Burr Member: Laminated and Bioturbated Carbonates	84
Plate 6	— Burr Member: Detail of the Lower Dolomite, and Typical Hardgrounds of the Limestones	86
Plate 7	— Burr Member: Poorly Defined Hardgrounds	88
Plate 8	— Burr Member: Microscopic Detail of Lithologies Across Hardgrounds	90
Plate 9	— Burr Member: Partial Dolomitization	92
Plate 10	— Neely Member: Fossiliferous Carbonates	94
Plate 11	— Neely Member: Microscopic Detail of Carbonates	96
Plate 12	— Upper Neely Member: Photomicrographs of Pelleted Carbonates	98
Plate 13	— Upper Neely Member: Bituminous Carbonates	100
Plate 14	— Upper Neely Member: SEM Photographs of Bituminous Carbonate; also Algal Growths	102
Plate 15	— Upper Neely Member: Interbedded Dolomite and Anhydrite	104
Plate 16	— Upper Neely Member: Anhydrite	106
Plate 17	— Halite in the Upper Neely Member and Hubbard Evaporite	108
Plate 18	— Upper Neely Member: Porosity and Fossils Plugged with Halite and Gypsum	110
Plate 19	— Microkarst Feature (1), and Fractures Plugged with Halite	112
Plate 20	— Microscopic Detail of Fractures and Cracks	114
Plate 21	— Results of Solution Collapse	116

ABSTRACT

Carbonates and evaporites of the Dawson Bay Formation overlie the salt beds of the Prairie Evaporite in the 24,000-km^2 area of central Saskatchewan considered in this study. The geology of the formation is relevant to the operations of six potash mines, in that the ore is extracted from the Patience Lake Member, only a few metres beneath the Dawson Bay.

The formation underlies the Souris River Formation and is Givetian in age. The current subdivision of the Dawson Bay Formation into six units is reduced here to four formally defined members (in ascending order):

1. Second Red Bed Member, composed of dolomitic mudstone;

2. Burr Member (new name), composed of limestone with some dolomite, and characterized by abundant discontinuity surfaces ("hardgrounds");

3. Neely Member (new name), composed of stromatoporoidal limestone capped with dolomite and anhydrite;

4. Hubbard Member, composed of halite.

The sediments were deposited in shallow tropical seas relatively free of clastic material. Hardgrounds give witness to at least 25 occasions when sedimentation temporarily ceased. Evaporation of the sea left the Hubbard halite in the eastern part of the study area. Later, porosity of the sediments was plugged with halite over thousands of square kilometres.

Cores of the Dawson Bay show abundant near-vertical fractures. Structure contours indicate regions of major subsidence due to solutioning of the Prairie Evaporite with associated severe brecciation of the Dawson Bay strata. Moreover, regions of relatively thin salt above the potash-rich Patience Lake Member are considered evidence for partial solutioning.

The potash mines are situated beneath Dawson Bay strata which are dry. Water-bearing zones in the Dawson Bay trend north-easterly, and are coincident with seismic lows. Sparse water pressure data permit a tentative evaluation of the potentiometric surface: decline is toward the northeast, and elevations are coincident with those in the Mannville indicating connection between the formations. A possible potentiometric cell exists southwest of Saskatoon.

Rock mechanics data show that Dawson Bay rocks are generally very strong, and are of the moderately high elasticity expected for carbonates. Compressive strengths are relatively low in the presence of abundant fauna, bituminous laminae, and hardgrounds.

Keywords: Central Saskatchewan, Middle Devonian, Givetian, Dawson Bay Formation, Prairie Evaporite, Potash, Carbonates, Stratigraphy, Sedimentology, Diagenesis, Depositional Environment, Structure, Rock Mechanics, Paleontology, Geochemistry, Formation Waters

Dunn, C. E. (1982): Geology of the Middle Devonian Dawson Bay Formation in the Saskatoon potash mining district, Saskatchewan; Saskatchewan Mineral Resources, Report 194.

INTRODUCTION

Scope of Study and Introductory Comments

This report comprises a study of information obtained from all 315 wells drilled to the Dawson Bay Formation between Townships 30 and 40 inclusive, and from Range 20 west of the Second Meridian to Range 14 west of the Third Meridian inclusive (Fig. 1). Within this 24,000-km^2 (9000 mi^2) area six potash mines are situated. A knowledge of the geology of the Dawson Bay Formation and its relationship to underlying potash beds of the Prairie Evaporite is important to potash mine operations.

Most of the data from which the report is compiled are in Imperial units, hence they are presented in this form with the metric equivalent alongside. Data recorded in feet have been rounded to the closest metre, except where more accuracy is deemed necessary.

Study Area

Outcrop of Dawson Bay Formation (after Bannatyne, 1975)

Subsurface extent of Dawson Bay Formation (after Grayston et al., 1964); northern erosional edge after Paterson, 1975, and Fuzesy, 1980.

A—A' Line of regional cross section (see Fig. 2)

Fig. 1: Location, Outcrop and Subcrop Map of the Dawson Bay Formation

Precision in picking a contact from a geophysical well log varies considerably, and is dependent upon the quality of instrumentation used on the well, the sharpness of the lithologic change, and the type of log: for the Dawson Bay Formation, electric logs are less precise than the gamma ray/neutron or gamma ray/sonic logs, and the top of the formation is usually less clearly defined than the base. Furthermore, in a few wells a gamma ray/neutron log may record a stratum at a depth 2 to 3 ft different from that indicated on a gamma ray/sonic log, due to either instrument or operator error. In a number of wells the gamma ray log is offset by up to 8 ft (2.4 m) from the neutron log. On some of these logs it is indicated that the gamma-ray log is in error, hence the neutron log has been taken as the standard. Despite these problems, it is concluded that a pick can generally be made within two feet of its true depth. Petrographic descriptions in the text are brief, but are amplified alongside the many appended photographs of macro- and micro-features.

Previous Work

Whiteaves (1891, 1892), Tyrell (1892) and Kindle (1914) document limestone outcrops in Manitoba which later proved to be the closest outcrops of the Dawson Bay Formation to the subsurface strata of the present study. Work by Wickenden (1934), McGehee (1949), Baillie (1951), Andrichuk (1951), and Powley (1951), describes various Devonian sequences beneath the plains of western Canada, and in 1953 Baillie defined the Dawson Bay Formation. Stanton (1953), MacLennan and Kamen Kaye (1954), Price (1955), Warren and Stelck (1956), Walker (1957), and Edie (1958 and 1959) all contribute to an understanding of the paleontology, sedimentology and stratigraphy. Studies by Crickmay (1954, 1960 and 1961) throw further light upon the stratigraphic problems.

Lane (1959) is the only detailed study of the Dawson Bay Formation in Saskatchewan thus far published. His report covers part of eastern Saskatchewan and overlaps part of the present study area. Lahey (1964) describes the Second Red Bed (basal Dawson Bay) over the southern part of the area considered in this report. Preliminary information on the Dawson Bay in the present study area is in Dunn (1975a, 1976, 1980).

STRATIGRAPHY

General

Regional correlations of the Dawson Bay Formation and its stratigraphic position are illustrated in Figure 2. Powley's (1951) 'Hudson Bay Formation' is nearly synonymous with the Dawson Bay Formation of Baillie (1953): the only difference is that Powley's sequence includes a red mudstone bed (the First Red Bed) which is now considered to be the basal unit of the overlying Souris River Formation. The type area displays carbonates which outcrop on the shore of Dawson Bay, in the northwest corner of Lake Winnipegosis, Manitoba. Baillie (1953) considers the formation to comprise the lowermost of several cycles of sedimentation which make up the Manitoba Group. Whereas the Manitoba Group straddles the Middle/Upper Devonian boundary, the Dawson Bay is Middle Devonian. According to McCammon (1960) Dawson Bay atrypid brachiopod and tetracoral assemblages show close affinity to the Cedar Valley Formation of Iowa and Minnesota. It is suggested by Savage and Van Tuyl (1919), on the basis of the faunal assemblages, that the eastern extension of sedimentary rocks of this age is represented by the Williams Island Formation in the James Bay and Abitibi region. In western Saskatchewan the Dawson Bay Formation thins to red beds containing sparse fauna. In central Alberta it can be correlated with clastic deposits of the Watt Mountain Formation (Fig. 2), and in northwestern Alberta probably with the Presqu'ile Formation (Bassett and Stout, 1967, p. 740).

Current work on ostracods (Matthieson, *pers. comm.*) indicates that during deposition of the lower half of the Dawson Bay sequence the fauna and sediments were derived from the east. The fauna is open-marine and includes *Octanaria*, a genus typical of the Michigan area. However, sediments comprising the upper half of the formation contain fauna indicative of a western influence (notably *Leperditia*, a genus found in the Swan Hills reefs).

Brachiopod and coral assemblages, and in particular the large thin-shelled terebratulid *Stringocephalus burtini* Defr., indicate that the stratigraphic stage is Givetian (late Middle Devonian). Conodont assemblages in Manitoba confirm this by the presence of the stratigraphically critical species *Polygnathus alveoliposticus* Orr and Klapper, and *Icriodus eslaensis* van Adrichem Boogaert (Norris and Uyeno, 1971), which assign the Dawson Bay to the *Polygnathus varcus* Zone of Givetian age.

Nelson (1975, p. 592, Fig. 2) figures a crinoid ossicle with two holes named *Gasterocoma*, which he considers diagnostic of late Lower Devonian and early Middle Devonian (Upper Emsian to Middle Eifelian). Similar ossicles [Pl. 1(1)] were noted during the course of the present study, but their presence is considered to extend the range of *Gasterocoma* rather than to indicate an older age for the Dawson Bay. Two-holed crinoid stems have also been found in a road cut at Volga, Manitoba (Dunn & Kendall, 1978). These beds, originally thought to be the First Red Bed of the lower part of the Souris River Formation (Kent & Paterson, 1967), are now taken to be Middle Shale unit (C) of Bannatyne (1975), and thus in the same stratigraphic interval as that of the ossicle figured in Plate 1 (1).

Detailed Stratigraphy

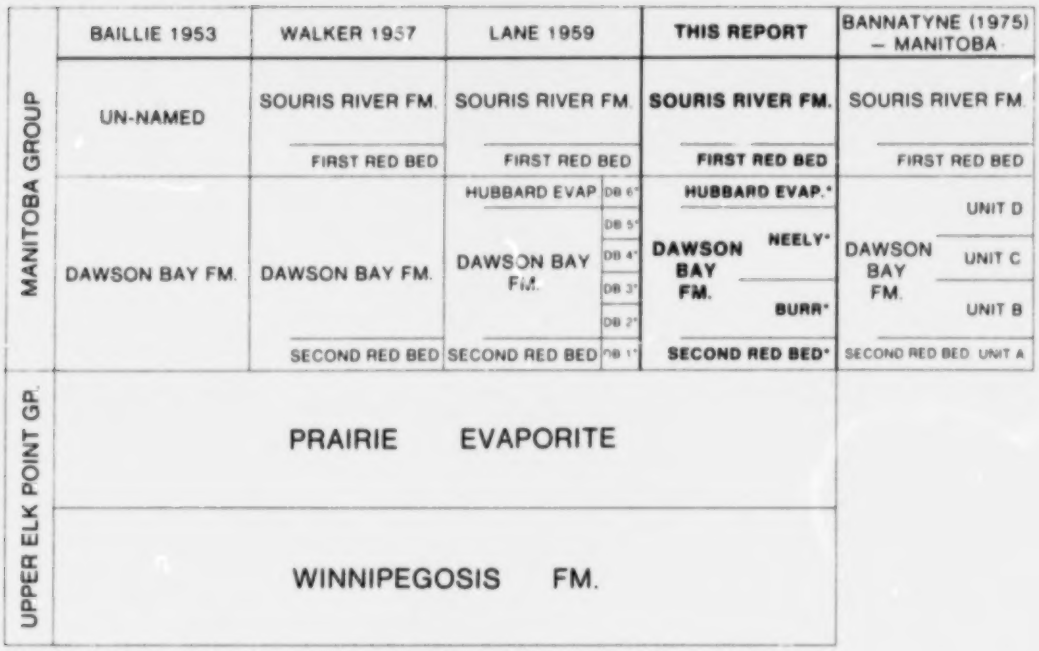
The Dawson Bay Formation within the study area ranges in thickness from 184 ft (56 m) in the east to 102 ft (31 m) in the west, and lies at a general depth of 2950 ft (900 m) in the north, and about 3300 ft (1000 m) in the south, although locally deeper. An isopach map (Fig. 3) snows there to be little regional variation in the thickness of the formation, except in the west where thickness greater than about 130 ft (40 m) is attributed entirely to the presence of the Hubbard halite. The formation rests disconformably on the Prairie Evaporite or, where the salts have been dissolved, upon carbonates or anhydrite of the Winnipegosis Formation. The contact with the overlying First Red Bed of the Souris River Formation is transitional.

Lane (1959) divides the Dawson Bay Formation in Saskatchewan into six members, designated in ascending order DB1 to DB6 (Fig. 4). Bannatyne (1975, p. 60) recognizes "four distinct and correlatable lithologic units" in Manitoba, which do not correspond precisely to Lane's boundaries. In view of the discrepancies which exist and in the light of the abundance of subsurface material available since Lane's study was carried out, a simpler subdivision of the Dawson Bay Formation (Fig. 4) is here proposed. The well log responses and newly proposed members are illustrated in Figure 5.

Proposed Nomenclature for Members of the Dawson Bay Formation

Second Red Bed Member

These strata have been known as the 'Second Red Bed' for many years, and correspond to Lane's (1959) DB1 Member. The sequence is here formally defined as a member, and the geophysical logs of a selected type well are illustrated in the cross section (Fig. 5).



* – MEMBER

Fig. 4: Stratigraphic Nomenclature of the Middle Devonian in Saskatchewan and Manitoba

Type Section: Second Red Bed Member

Noranda Neely 16 21 34 27

Lsd. 16-21-34-27W2

K.B. 1806 feet (550 m)

Interval: 3300-3314 feet (1005.8 to 1010.1 m)

Depth in feet (metres)	Description
	Overlying bed: Halite cemented carbonate breccia, bituminous residue and anhydrite at the base of the Burr Member.
3300-3306 (1005.8-1007.7)	Dolomitic mudstone, greenish-grey to grey. Uppermost 5 cm composed of grey disturbed laminae with annealed microfaults and a microbreccia. Underlying sediments are shaly and less well-consolidated. A few small (1 cm diameter) bluish translucent anhydrite nodules in upper part. A vertical fracture filled with fibrous orange halite terminates in the laminated beds.
3306-3310 (1007.7-1008.9)	Dolomitic mudstone, olive to olive-brown. Veins of orange halite. Poorly consolidated.
3310-3314 (1008.9-1010.1)	Dolomitic mudstone, reddish brown. Riddled with veins of orange halite. Very poorly consolidated. Local greenish bands. Transitional lower contact. Underlying beds: halite of the Prairie Evaporite.

The Second Red Bed Member gives a well-defined positive response to gamma-ray logs in the study area. It ranges in thickness from 10 to 20 ft (3 to 6 m), but is generally about 14 ft (4 m) thick, and exhibits little regional change in lithology. Eastward from the study area there is an increase in the argillaceous content of the lower portion of the overlying Burr Member (cf. Fig. 5), in addition to a thickening of the Second Red Bed. The main criterion for delimiting the contact is the presence of a hiatus [Pl. 1 (2)] which occurs usually 14 ft (4 m) above the base of the Second Red Bed, but nearer 30 ft (9 m) above the base farther east; e.g. Pheas Dome et al Endeavor, Lsd 10-12-37-6W2 (Fig. 5). In Manitoba the sequence is 30 to 40 ft (9 to 12 m) thick (Bannatyne, 1975).

The lower contact is disconformable with the Prairie Evaporite, whereas the upper contact shows minor (locally angular) unconformity with carbonates of the Burr Member.

80 km / 50 mi. — 127 km / 79 mi. — 10 km / 6 mi. — 19 km / 12 mi.

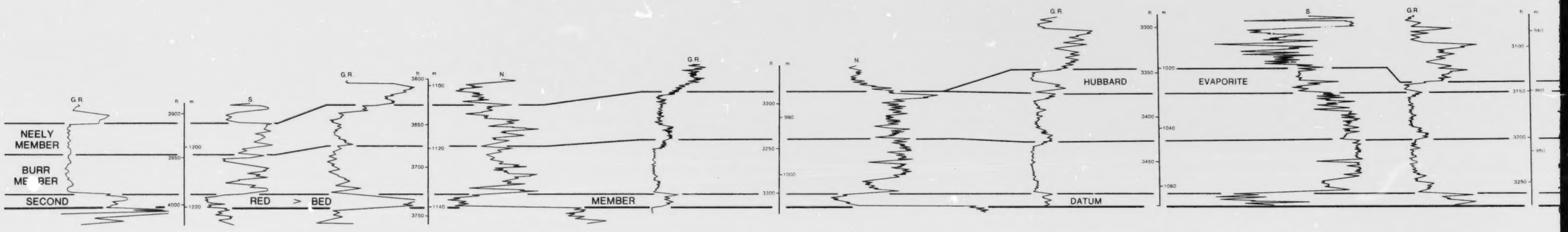
1
CPOG LEIPZIG 2 30 37 19
LSD 2-30-37-19W3
K.B. 649 m / 2214 ft

2
GULF TIDEWATER HANSEN NO 16
LSD 16-11-35-12W3
K.B. 562 m / 1844 ft

3
NORANDA NEELY 16 21 34 27
LSD 16-21-34-27W2
K.B. 550 m / 1806 ft

4
SHELL YOUNG 5 31 33 26
LSD 5-31-33-26W2
K.B. 555 m / 1821 ft

5
DAFOE WOLVERINE 4
LSD 4-16-35-25W
K.B. 554 m / 1819 ft



101 km / 63 mi. — 92 km / 57 mi. — 64 km / 40 mi.

6
DOMINION POTASH BURR NO 4 18
LSD 4-18-35-23W2
K.B. 562 m / 1844 ft

7
PHEAS CHEV DOME QUILL L 8 16 37 15
LSD 8-16-37-15W2
K.B. 555 m / 1820 ft

8
PHEAS DOME ET AL ENDEAVOR 10 12 37 6
LSD 10-12-37-6W2
K.B. 575 m / 1886 ft

9
WOODLEY ADA THUNDERHILL 4A 5
LSD 4-5-35-31W1
K.B. 489 m / 1604 ft

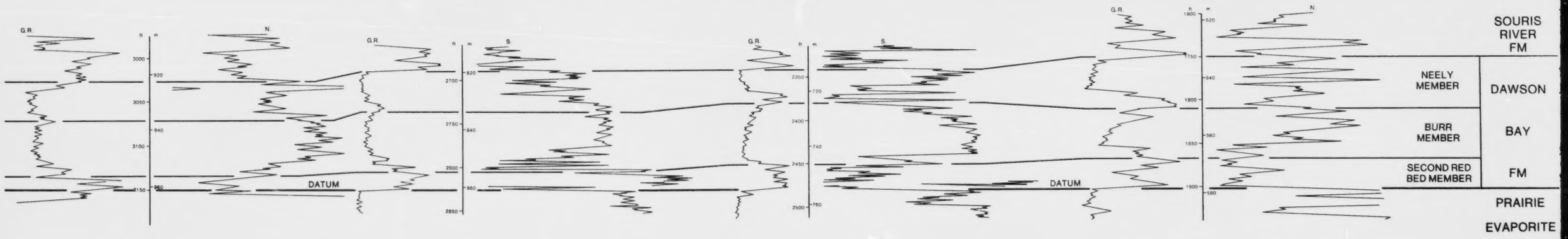


Figure 5: Cross Section of Dawson

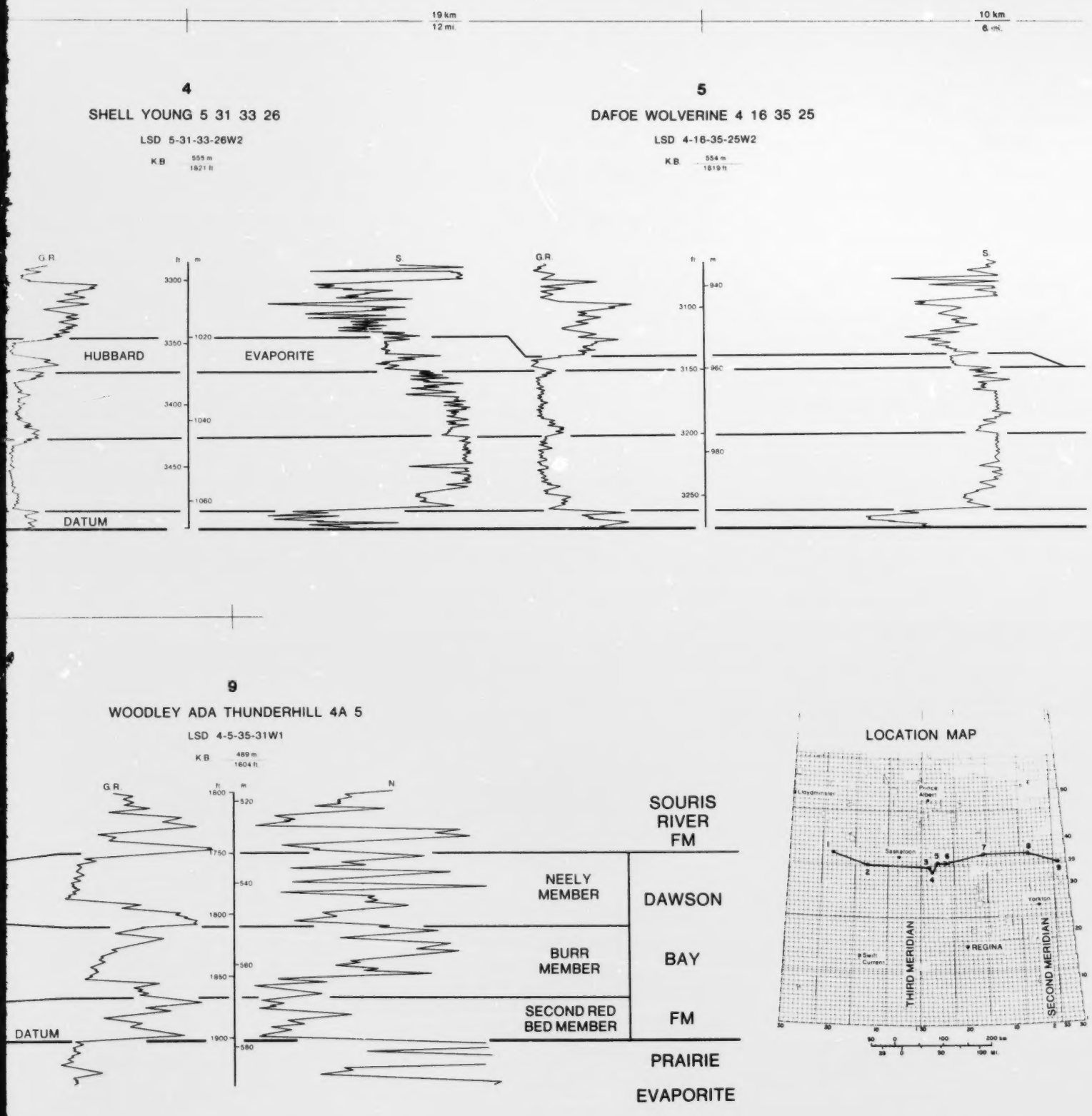


Figure 5: Cross Section of Dawson Bay Stratigraphy in Central Saskatchewan

Burr Member

This member includes the DB2 member of Lane (1959) and all but the uppermost poorly fossiliferous argillaceous carbonate bed of his DB3 member. The limits of the Burr Member are defined by a basal unconformity with the Second Red Bed (usually commencing with a *1 mm to 2-cm thick oil shale* and sometimes a thin breccia), and an upper disconformity with carbonates of the Neely Member. It maintains a regional thickness of about 65 ft (20 m). The upper contact corresponds with the top of Bannatyne's (1975) 'B' unit in Manitoba. This sequence can rarely be further subdivided by geophysical well-log responses, although Lane's (1959) two units can often be recognized in cored sections by a hiatus [Pl. 1(3)] — usually the lowermost of many discontinuity surfaces ('hardgrounds') which characterize the member. Lane's rationale for separating DB2 from DB3 was based on the comparatively low resistivity of DB 3 on focused deep penetration resistivity logs. This response corresponds to the degree of halite impregnation, which in turn may depend on the amount of pore space created by dolomitization; hence the boundary varies from well to well according to the relative abundances of dolomite and halite.

The upper limit of the Burr Member is taken at the base of an argillaceous marker bed near the middle of the formation. In the southwestern quarter of the study area the argillaceous content is low, so that from the geophysical well logs it is difficult to separate the Burr Member from the overlying Neely Member unless high quality logs are available. Elsewhere in the study area the top of the Burr Member is defined by:

a) a sharp gamma-ray response at the base of the argillaceous carbonate;

b) the presence of a pronounced hiatus, locally indicated by a clearly defined erosion surface (Frontispiece);

c) a faunal change from dominantly corals, bryozoans, and pelmatozoans beneath the diastem to sparse brachiopods and stromatoporoids above.

Type Section: Burr Member (Fig. 5)

Dominion Potash Burr No. 4 18

Lsd. 4-18-35-23W2

K.B. 1847 ft (563 m)

Interval: 3072-3135 ft (936.3-955.5 m)

Depth in feet (metres)	Description
	Overlying bed: poorly fossiliferous argillaceous greenish-grey limestone at the base of the Neely Member.
3072-3122 (936.3-951.6)	Limestone, microcrystalline, medium grey to brown. Mottled by bioturbation. Corals, crinoid ossicles, brachiopods. Occasional needles of translucent brown anhydrite. Twenty hardgrounds, spaced at irregular intervals, each of which are extensively burrowed, and usually exhibit a colour change of the sediment from grey beneath to pale brown above.
3122-3126 (951.6-952.8)	Limestone, dolomitic, microcrystalline to microsucrosic. Medium to dark grey, and finely mottled throughout due to extensive bioturbation. No macrofossils. Few blebs of whitish anhydrite. Gradational into:
3126-3135 (952.8-955.5)	Dolomite, sucrosic, drab olive-brown, mottled. Porosity filled with halite. Lowermost few centimetres finely laminated. Underlying bed: grey, very fine-grained dolomitic mudstone of the Second Red Bed Member.

Neely Member

The Neely Member comprises Lane's (1959) DB4 and DB5, and the argillaceous carbonate at the top of DB3. The Neely Member corresponds to the C and D units of Bannatyne (1975) in Manitoba and maintains a thickness of 50 to 60 ft (15-18 m) from the study area across to Manitoba. The main difference from the Manitoba sequence is the lesser amount in Saskatchewan of argillaceous carbonates in the lower part of the sequence. Lane (1959) describes stromatoporoids and dolomitic limestones as characteristic of DB4, whereas DB5 consists of fossiliferous brown and black limestones, buff pelletoidal limestones and dolomitic anhydrites. He notes, however, that the contact between these members is "uncertain on mechanical logs", thus making it difficult to define a division, particularly in the absence of cored sections: even where cored it is rarely possible to pinpoint the junction. In view of the inconsistency of the other criteria in separating the members (e.g. presence or absence of stromatoporoids, gastropods, bituminous limestones) the sequence is combined here under the one name of the Neely Member (Fig. 5).

Type Section: Neely Member

Noranda Neely 16 21 34 27

Lsd. 16-21-34-27W2

K.B. 1806 feet (550 m)

Interval: 3188-3240 ft (971.7-987.6 m)

Depth in feet (metres)	Description
	Overlying bed: green and red dolomitic mudstones with minor anhydrite, comprising the transitional zone at the base of the First Red Bed (Souris River Fm.)
3188-3192 (971.7-972.9)	Anhydrite, bluish-grey, dense, mixed with greenish dolomitic mudstone, and buff cryptocrystalline dolomite. Includes three 3 cm-thick bands of dolomitic mudstone intimately mixed with orange halite.
3192-3194.5 (972.9-973.7)	Limestone, microcrystalline: upper half black and bituminous with halite-filled vugs and dwarf gastropods; lower half faintly laminated, buff, unfossiliferous, with small "birds-eye" vugs plugged with halite.
3194.5-3196.5 (973.7-974.3)	Anhydrite, bluish-grey, dense, intermixed with buff cryptocrystalline dolomite.
3196.5-3197.3 (974.3-974.5)	Dolomitic limestone, finely sucrosic, laminated, ?algal mats. Greenish dolomitic mudstone streaks in lower part.
3197.3-3200.6 (974.5-975.5)	Limestone, bituminous, microcrystalline, medium to dark brown. Halite filled gastropods and vugs.
3200.6-3203.1 (975.5-976.3)	Limestone, sucrosic to microcrystalline, buff, laminated. Polymict breccia (40 cm thick) at the base contains anhydrite, carbonate fragments and a stromatoporoid. Probably a micro-karst feature.
3203.1-3217 (976.3-980.5)	Limestone, slightly bituminous, medium brown, microcrystalline to sucrosic. Scattered small and large stromatoporoids and stringocephalid brachiopods. Bryozoans and solitary corals. Bluish anhydrite blebs. Entire sequence plugged with halite.
3217-3226.3 (980.5-983.4)	Limestone, microcrystalline, dark brown and bituminous. Abundant stromatoporoids, bryozoans and corals. Halite-filled vugs; bluish nodules of anhydrite.
3226.3-3240 (983.4-987.6)	Limestone, microcrystalline to cryptocrystalline, argillaceous, medium to pale olive-brown; poorly fossiliferous (scattered crinoid ossicles including the "two-hole" *Gasterocoma* ; bryozoans, gastropods and corals). Lower part extensively bioturbated. Nodules of bluish anhydrite; halite-filled vugs. Several minor hardgrounds.
3240 (987.6)	Base marked by a pronounced burrowed erosion surface [cf. Pls. 1(3), 1(4)] beneath which are buff microcrystalline crinoid and brachiopod limestones of the Burr Member.

Hubbard Evaporite

This member was named by Lane (1959) who also referred to it as the DB6 member. It is defined as a halite bed which reaches a maximum thickness of 62 ft (19 m) in the Cal-Stan TW Hubbard 1 28 24 10(W2) well. Within the study area a maximum of 46 ft (14 m) is present in the Kerr-McGee Jansen 9 26 33 20(W2) well. A map showing the extent of the halite and its thickness is superimposed on an isopach map of the formation in figure 3, and the geophysical well log signature is shown in figure 5. Whereas pure halite beds less than 3 ft (1 m) thick are well defined on sonic logs, difficulty arises in determining the thickness of the member in older wells for which only electric logs or gamma-ray/neutron logs with low sensitivity are available. The problem is commonly aggravated by the presence of interbedded red dolomitic mudstone, anhydrite and cryptocrystalline dolomite, which interrupt the halite signature and create uncertainty as to whether or not halite is present. An example of this is the Alwinsal Dellwood 3 10 34 23(W2) well (see core description, Appendix II) where interbedded and intermixed laminae of mudstone and halite occur beneath a bed of transparent crystalline halite. Thus, in the absence of evidence from core, the edge of the Hubbard Evaporite can not be plotted with confidence at all locations, and its limit is inferred by dashed lines (Fig. 3).

A similar problem arises in defining the base of the First Red Bed of the Souris River Formation. It is probable that some of the red mudstone represents residual material from dissolution of Hubbard Evaporite salt [e.g. Kerr McGee Esk 8 20 33 20(W2)]. Hence the upper limit of the Dawson Bay Formation is taken not at the first appearance of red beds, but at the last appearance of halite. Where halite is absent (e.g. Noranda Neely 16 21 34 27(W2) — Fig. 5) the limit is best taken at the upward change from anhydrite to dolomitic mudstone as the dominant lithology.

Discussion

Workers on the Devonian of the Interior Plains are in general agreement that the sediments are products of cyclic sedimentation, and that the Dawson Bay Formation represents one cycle. In such an interpretation the question arises as to where a cycle begins and ends. Whereas the Dawson Bay Formation extends from the base of the Second Red Bed to the top of the evaporite phase (with the First Red Bed defining the commencement of a cycle), a case can be made for placing the cycle limits at other horizons. Cycles of the Upper Devonian Duperow Formation are considered to terminate at the top of each dolomitic mudstone (Wilson, 1967, p. 245; Kent, 1968, p. 12; Dunn, 1975b, p. 27). In the case of the Dawson Bay Formation it would therefore seem appropriate to include the Second Red Bed with the Prairie Evaporite, and the First Red Bed with the Dawson Bay (Fig. 6). The presence of a discontinuity, locally emphasized by brecciation, between the Second Red Bed and the Dawson Bay carbonates [cf. Lane, 1959, p. 20, and this report, Pl. 1(2)] adds weight to this interpretation. Whereas this reconstruction appears sound on a genetic basis, such redefinition of the formation boundaries would have major implications in the stratigraphic restructuring of the Middle and Upper Devonian, and, though of academic interest, would serve little practical purpose. Hence, traditional usage is followed throughout this report.

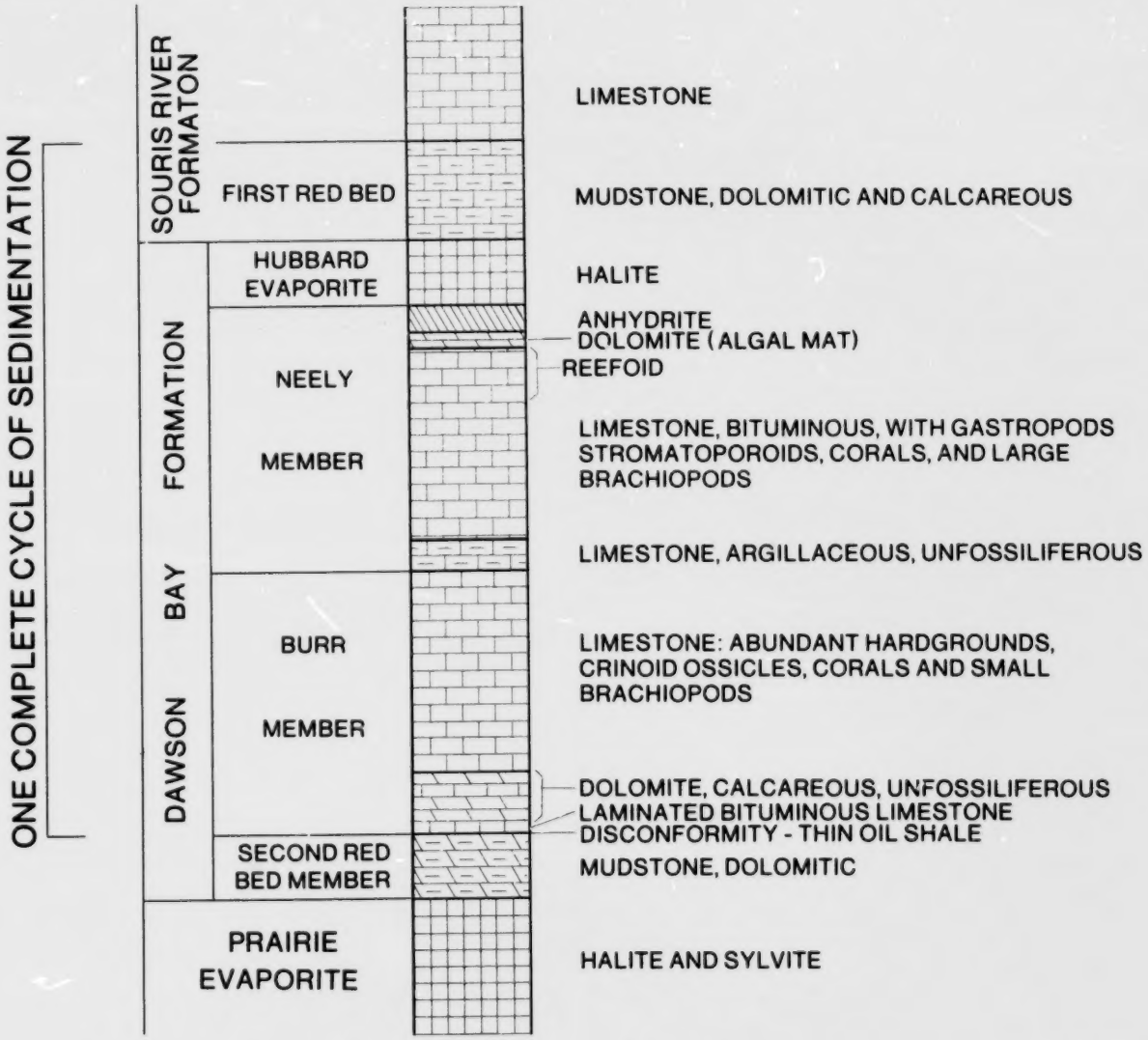


Figure 6: Idealized Dawson Bay Sequence in Relationship to a Cycle of Deposition

PETROGRAPHY

General

The dominant lithology of the Dawson Bay Formation is micro- to crypto- crystalline fossiliferous limestone exhibiting varying degrees of dolomitization. The lowermost carbonates are commonly dolomite, and a thin bed of dolomite underlies the uppermost evaporite strata. Carbonate pores are commonly plugged with secondary halite. Secondary anhydrite occurs scattered throughout the sequence, whereas primary anhydrite is restricted to the evaporites at the top of the formation.

Table 1 indicates the predominance of limestone, which rarely varies more than 5 percent from a thickness of 100 ft (30 m).

Component	Percentage
Limestone (including dolomitic limestone)	60 - 80
Dolomite	1 - 20
Mudstone (dolomitic)	10 - 20
Anhydrite	2 - 5
Halite	0 - 30

TABLE 1: Lithologic Composition of the Dawson Bay Formation

Dolomite always occurs at the expense of limestone. The carbonate/mudstone sequence retains its regional thickness, but where present the halite cap always adds to the thickness of the formation. A typical distribution of these lithologies in the section is shown in figure 6.

Regional trends are:

1. Uniform thickness of the mudstone, carbonate and anhydrite;
2. Restriction of the halite (Hubbard Evaporite) to east of the Third Meridian and south of Township 37;
3. Restriction of halite-plugged porosity to the southern half of the area;
4. More dolomitization of the lowermost carbonates in the east than in the west.

Mudstone of the Second Red Bed Member

Mudstone is largely confined to and comprises the Second Red Bed Member.

A similar lithology occurs as thin beds within the transition zone into the Souris River Formation. The Second Red Bed is completely different in character from the rest of the formation. It is a non-calcareous dolomitic mudstone, locally shaly, red (sometimes with green mottles) at the base grading through brown to grey at the top. It is poorly cohesive and readily fractures into small curve-faced blocks [Pls. 2(1), 2(2)].

The past passage of ion-rich waters through the sediments is witnessed by the presence of tiny anhydrite needles and the commonplace impregnation by halite, particularly in the red part where horizontal and vertical veins of white or orange halite several centimetres thick are locally present. Outwardly the sediments are homogeneous but detailed examination, with the aid of acetate peels, reveals fine laminae and, locally microbrecciation [Pl. 2(3)] and contorted internal structure. The basal contact with the Prairie Evaporite may be sharp yet undulating [Pl. 2(4)], or exhibit intimate mixing [Pl. 3(1)]. In that the contact is sometimes sharp, it may be considered that the relationship between the beds is disconformable. However, a minor erosion surface would have formed readily on the exposed salt surface, hence there may have been very little time between deposition of the salt and deposition of the overlying mudstone. The contact can best be described as a diastem. Where the salt is absent, underlying anhydrite of the Prairie Evaporite or Winnipegosis Formation is usually intimately mixed with the dolomitic mudstones [Pls. 3(2), 3(3)].

The red part of the sequence is usually about 6 ft (2 m) thick, but varies from 0 to 10 ft (3 m). It owes its colour to the presence of finely disseminated iron oxides, locally reduced to give green mottling or banding. The overlying brown mudstone differs from the red only in that it is usually more cohesive. It rarely exceeds a thickness of 3 ft (1 m) before grading into the grey shales and mudstones which typify the uppermost 6 to 10 ft (2 to 3 m) of the Second Red Bed. Locally [e.g. Goldfield Grt Cdn Dundurn 10 7 32 5(W3)] the red phase is absent and the sequence comprises greenish to olive-grey mudstone. The uppermost part of the grey sequence invariably displays much better cohesion than the underlying strata, and subtle colour changes reveal the laminated nature of these sediments [Pls. 4(1), 4(2)]. Small scale brecciation can be detected in many cores just beneath the laminated strata [Pl. 4(3)].

WELL NAME	LOCATION	DEPTH ft (m)	LITHOLOGY	DOLOMITE %	MINERALOGY* Dolomite	Calcite	Quartz	Anhydrite	Halite	Illite	Kaolinite	TRACE METAL COMPOSITION (ppm) U	Cu	Ni	Pb	Zn	Co	Mn	Fe(%)
Dominion Potash Burr No. 4 18	4-18-35-23W2	3145 (959)	Red dolomitic mudstone	70	1		3				3	1.4	–	–	–	–	–	–	–
		3148 (960)	Red mudstone	15	3		3	1	3			0.9	–	–	–	–	–	–	–
SWP Boulder Lake 5 15 30 23	5-15-30-23W2	3442 (1049)	Grey shaly mudstone	74	1		4			2		1.0	–	–	–	–	–	–	–
		3451 (1052)	Red dolomitic mudstone	71	1		3			4		1.3	–	–	–	–	–	–	–
		3453 (1053)	Red/green dolomitic m/stn. with halite	–	2		2	2	2	3	4	–	–	–	–	–	–	–	–
Duval Potash Co Viscount 5 18 34 25	5-18-34-25W2	3472 (1058)	Grey dolomitic mudstone	92	1**		3		4			0.6	–	–	–	–	–	–	–
		3484 (1062)	Red dolomitic mudstone	42	1**	3†	2	1	3	3		1.3	–	–	–	–	–	–	–
		3486 (1063)	Red dolomitic mudstone (basal)	40	1	3†	2	3	3		3	1.6	–	–	–	–	–	–	–
Kennco 3 Prudhomme 12 10 38 28	12-10-38-28W2	3053 (930)	Grey dolomitic mudstone	74	1	3†	2		2	3		1.7	12	39	27	34	26	244	1.1
		3059 (932)	Brown dolomitic mudstone	57	1		4			3	4	1.5	15	43	13	34	24	206	1.7
		3062 (933)	Red dolomitic mudstone	58	1	3†	2			2		1.9	8	48	16	36	25	230	3.3
		3067 (935)	Red dolomitic mudstone (basal)	40	2		2	3	1	3	4	1.3	14	41	18	26	26	173	1.3
Imperial Fortune 13 20 30 14	13-20-30-14W3	4643 (1415)	Red bed matrix of carbonate breccia	–	1	2	2	2		4		–	–	–	–	–	–	–	–

*1 = major component
2 = major component, but less than (1)
3 = minor component
4 = trace component
** = Fe – rich dolomite
† = Mg – calcite
– = not determined.

U determined by neutron activation/delayed neutron counting (at Atomic Energy of Canada Ltd.); other metals by atomic absorption spectrophotometry following a hot concentrated $HCl/HNO_3/HClO_4$ acid digestion (University of Regina laboratories)

TABLE 2: Mineralogy and Chemistry of the Second Red Bed Member

Fossil material is restricted to the uppermost few centimetres of the Second Red Bed where there are traces of borings and silicified ostracod tests [Pl. 4(4)].

The mineralogical constituents of the mudstones and a few chemical analyses are summarized in Table 2. Estimates of dolomite content (from X-ray diffractograms coupled with data on CO_2 loss on heating) in four wells indicate that the Second Red Bed exhibits an upward increase in carbonate content. From the few chemical analyses conducted for U, Cu, Ni, Pb, Zn, Co, Mn and Fe, no discernible patterns emerge, nor are there unusually high metal concentrations. Except for Ni and Co which are a little high, values are of the order to be expected from this type of lithology.

Fine-grained dolomite [Pl. 4(4)] comprises up to about 90 percent of the rock. The dolomite is commonly ferruginous and sometimes accompanied by traces of high Mg-calcite. Anhydrite, quartz and halite comprise a major part of the non-carbonate fraction. On the basis of a semi-quantitative X-ray diffraction study it appears that the clay mineral content (illite with subordinate kaolinite) rarely exceeds 20 percent of the red bed sequence. Lahey (1964) records chlorite, muscovite and biotite in the clay-size fraction of the Second Red Bed from five wells scattered across central Saskatchewan. These minerals were not detected in the -2μ m fractions separated for this study. It seems that the red and green colouration is due to traces of iron oxides coating the fine-grained minerals, in that no iron oxides are apparent in the diffractograms.

The contact between the Second Red Bed and the overlying carbonates is sharp and has a veneer of bituminous material which is sufficiently concentrated in some areas to produce an oil-shale (25 percent organic content) up to 4 cm thick, though usually less than 1 cm. In places a thin seam of secondary halite (< 1 cm) has been deposited within this poorly cohesive zone. Evidence for an unconformity is given by:

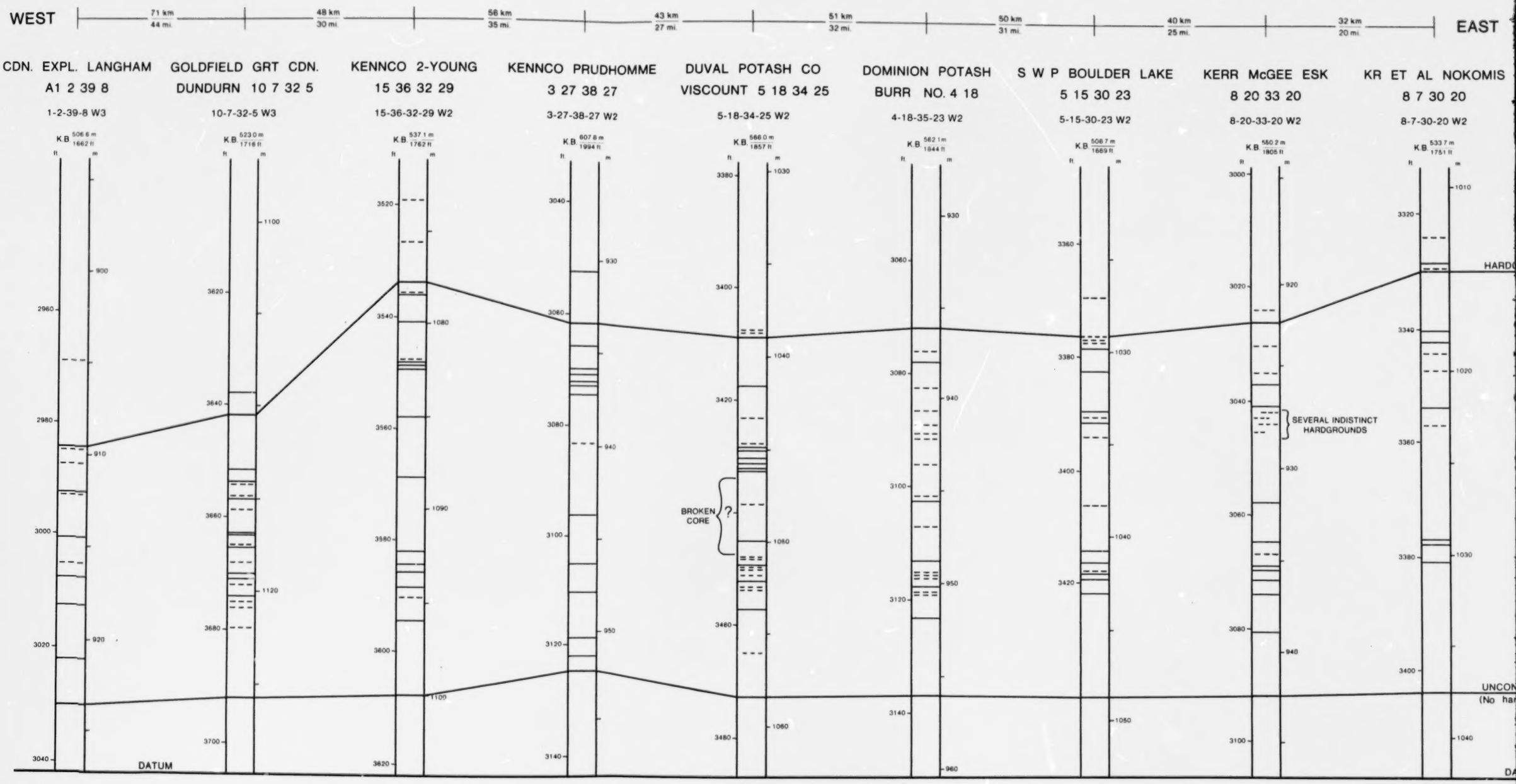
1. angular discordance (in most wells);
2. borings into the Second Red Bed, indicating lithification prior to deposition of the Burr carbonates;
3. compaction and dissolution of the uppermost Red Bed strata, giving rise to organic- and clay-rich veneers [Pl. 4(4)];
4. dislocation of the uppermost Red Bed strata (probably prior to carbonate deposition) leading to a) intraformational brecciation [Pl. 4(3)], and b) minor faulting [Pl. 4(2)].

Carbonates of the Burr Member

These strata rest with disconformity or minor angular unconformity upon mudstones of the Second Red Bed. At the base there is a thin band of black argillaceous and bituminous material, often overlain by a layer, a few centimetres thick, of brecciated carbonate [e.g. Noranda Neely, 16 21 34 27(W2)]. Commonly these are succeeded by a 20 to 30 cm thick unfossiliferous limestone with bituminous laminae [Pls. 5(1), 5(2), 5(3)], which grades upward into 10 to 14 ft (3 to 4 m) of drab olive-brown bioturbated, yet generally unfossiliferous carbonate [Pls. 5(4), 5(5)]. This sequence was identified by Lane (1959) as the '*Lingula* Phase', but no specimen of *Lingula* was found in this study. This carbonate is usually composed of dolomitic limestone and dolomite and is microcrystalline to microsucrosic [Pl. 6(1)].

The upward change into fossiliferous limestone is abrupt [Pl. 1(3)] and readily recognized in cored sections by a marked colour change from grey to buff, across a black irregularly burrowed surface (this is believed to be the contact between DB2 and DB3). This surface is one of many discontinuities or "hardgrounds" which can be recognized in the upper 60 ft (18 m) of the Burr Member. Only a few vestigial surfaces are present in the overlying Neely Member. They are irregularly spaced ranging from a few centimetres to several metres apart. Earlier recognition of surfaces of this nature is recorded by Prokopovich (1955) from the Ordovician of Minnesota, who attributes them to corrosion by bottom currents. Cumming *et al.* (1959) note that numerous sedimentary discontinuities occur throughout Paleozoic limestones of the Williston Basin. Reed (1970) suggests that periodic changes in the normal circulation pattern of marine currents trigger off erosion and submarine lithification processes. In Saskatchewan, surfaces similar to, but less pronounced than those of the Dawson Bay are present in the Ordovician Red River Formation (Kendall, 1976 Plate IX, C).

Close well control within the study area permits correlation of some surfaces with a moderate degree of confidence (Fig. 7), although no definite criteria can be applied to distinguish one hardground from another. Some appear at consistent stratigraphic levels; notably at the contact between the Neely and Burr Members, and 14 to 20 ft (4 to 6 m) above the Second Red Bed (i.e. at the lowermost hardground of the Burr Member. Several surfaces can be traced over 200 km. A further 200 km south-east from the study area, near Esterhazy, hardgrounds appear at similar stratigraphic levels, and hence are considered to be temporal equivalents of those around Saskatoon. Outcropping limestones of the Dawson Bay Formation on the western shore of Snake Island (in the south-west corner of Lake Winnipegosis, Manitoba) show burrowed bedding surfaces which possibly could be equated with those in Saskatchewan.


WEST
71 km 44 mi.
48 km 30 mi.
56 km 35 mi.
43 km 27 mi.
51 km 32 mi.
50 km 31 mi.
40 km 25 mi.
32 km 20 mi.
EAST
CDN. EXPL. LANGHAM A1 2 39 8
1-2-39-8 W3
K.B. 506.6 m 1662 ft
GOLDFIELD GRT CDN. DUNDURN 10 7 32 5
10-7-32-5 W3
K.B. 523.0 m 1716 ft
KENNCO 2-YOUNG 15 36 32 29
15-36-32-29 W2
K.B. 537.1 m 1762 ft
KENNCO PRUDHOMME 3 27 38 27
3-27-38-27 W2
K.B. 607.8 m 1994 ft
DUVAL POTASH CO VISCOUNT 5 18 34 25
5-18-34-25 W2
K.B. 566.0 m 1857 ft
DOMINION POTASH BURR NO. 4 18
4-18-35-23 W2
K.B. 562.1 m 1844 ft
S W P BOULDER LAKE 5 15 30 23
5-15-30-23 W2
K.B. 506.7 m 1669 ft
KERR McGEE ESK 8 20 33 20
8-20-33-20 W2
K.B. 550.2 m 1805 ft
KR ET AL NOKOMIS 8 7 30 20
8-7-30-20 W2
K.B. 533.7 m 1751 ft
BROKEN CORE ?
SEVERAL INDISTINCT HARDGROUNDS
HARD
UNCON
(No har
DATUM
DA

LEGEND

Datum : base of Dawson Bay Formation
——— = well developed hardground
- - - - = indistinct hardground

Fig. 7: Northwest-S
Showing th
the Burr Me

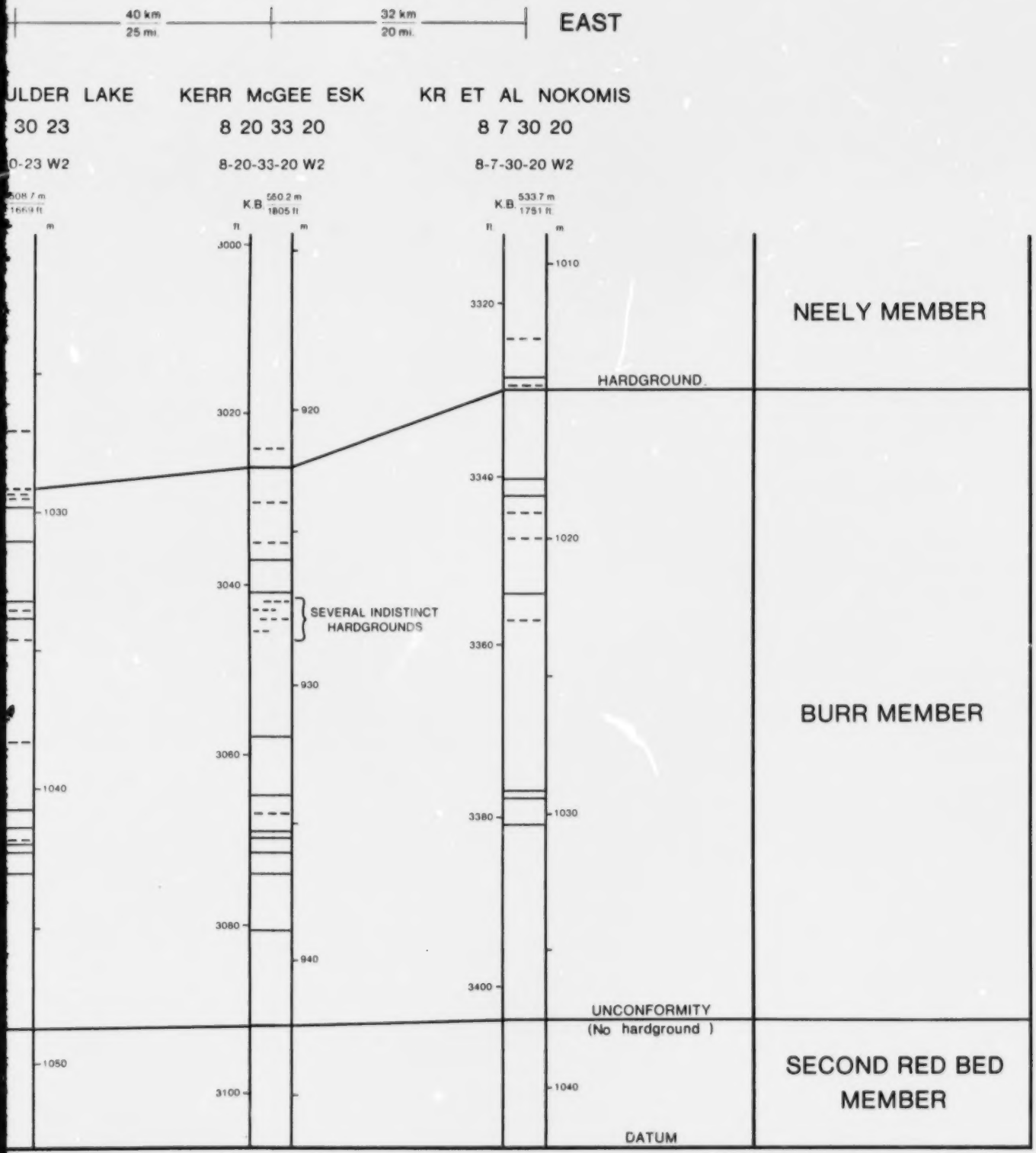


Fig. 7: Northwest-Southeast Cross Section of Wells Showing the Distribution of Hardgrounds in the Burr Member.

Some hardgrounds are clearly defined, whereas others are less easily discernible. They are most abundant in the Viscount district (Range 25, Townships 32-34) where twenty-five are present, whereas about twelve occur at the eastern and western extremities of the study area. They commonly exhibit a colour change from grey beneath to buff above. The grey may be due to slightly higher concentraions of argillaceous material, pyrite, or both: X.R.D. scans were not sufficiently sensitive to discern subtle mineralogical changes. Locally, hardgrounds occur as bands of closely spaced surfaces (e.g. Viscount area) often only a few centimetres apart. These bands tend to lie 20 ft (6 m) beneath the top of the Burr Member and about 20 ft (6 m) above its base. Some surfaces are eroded (or corroded) to a degree such that a surface may merge with an earlier surface, and the only evidence for the once-intervening sediments is preserved in burrows [e.g. Pl. 1(3)].

Typically, the surfaces have burrow indentations no more than 5 cm deep filled with lithoclasts and organic debris — notably pelmatozoan ossicles, calcispheres, fragments of corals, bryozoans and brachiopod shells, and orange to brown globules of kerogen (Pls. 6 and 7). Locally there are faunal accumulations above the hardgrounds, whereas elsewhere mainly lithoclasts are evident. The surfaces are considered to represent periods of nondeposition and submarine lithification of the substrate. From SEM photographs [Pls. 8(1), 8(2)] it is evident that the sediment beneath the hardground was annealed, presumably before deposition of the overlying sediments, by the precipitation of cryptocrystalline calcium carbonate over the grains. The sediment above the hardground is identical in grain size [Pl. 8(2)] to that beneath, but lacks the draping of grains by cryptocrystalline carbonate. In places there is evidence that erosion, also, has taken place (Frontispiece). The thin dark line of the surface appears much the same in thin section [Pls. 8(3), 8(4)] and is probably composed of very fine-grained pyrite.

Pyrite networks are not uncommon within the Burr Member, and acid etching of the rock shows [Pl. 9(1)] that they are restricted to the dolomitized part of the rock, whereas anhydrite needles are only present in the calcitic patches (see also Pl. 9(2)). This indicates that dolomitizing fluids dissolved some anhydrite thereby releasing sulphur, which then combined with iron to form pyrite.

Locally, dolomitization is incomplete and calcitic patches contain faunal fragments [Pl. 9(3)]: the surrounding dolomitic sediment has only vestiges of fauna. In places shells have served as shields against dolomitizing fluids [Pl. 9(4)] resulting in the preservation of faunal fragments in the sheltered lime mud. Anhydrite occurs as secondary needles and nodules scattered throughout the member. Secondary halite, plugging porosity, is present in the southern half of the study area (Lane, 1959, Fig. 10), and can be seen as chevrons displacing the lime mud, notably just above hardgrounds (Frontispiece).

Carbonates, Sulphates and Halite of the Neely Member

The basal 7 to 10 ft (2 to 3 m) of this 40 to 50 ft (12 to 15 m) thick member is an argillaceous carbonate [Pl. 10(1)] which rests upon a well-defined and widespread hardground, and is thus slightly disconformable with the underlying carbonates. It locally includes vestigial hardgrounds [e.g. K. R. Nokomis 8 7 30 20(W2)]. The succession is mainly limestone exhibiting varying degrees of dolomitization, and is microcrystalline to sucrosic. It commonly includes dark bituminous wisps, wavy laminae, or sometimes bands [Pl. 10(2)]. Corals and pelmatozoan ossicles, typical of the underlying member, persist throughout the lower half of this member, but in addition stromatoporoids (very rarely encountered in the Burr Member) and the large thin-shelled brachiopod *Stringocephalus* are common [Pls. 10(3) to (5)]. Fossil accumulations dominated by stromatoporoids are up to 5 m thick, and have a reefoid appearance in the Dundurn region [Goldfield Grt Cdn. Dundurn 10 7 32 5(W3)].

Dolomitized sequences commonly contain patches of lime mud and calcareous faunal fragments [Pls. 11(1), (2)]. Dolomite increases toward the north-west to become the only carbonate in the Canex Langham 1 2 39 8(W3) well. The sucrosic limestones are composed of calcite rhombs 50 to 80μm in diameter [Pl. 11(3)], set in a matrix of finer-grained ($< 5\mu$m) calcite [Pl. 11(4)]. The dolomitic limestone typical of the member comprises closely packed crystals with some pore spaces [Pl. 11(5)].

The upper part of the member is commonly a pelleted bituminous limestone containing ostracods and gastropods (Pls. 12 and 13). The bituminous material is in part contained within halite crystals giving them their black appearance, and in part occurs between carbonate crystals as tiny globules which coalesce to give a reniform texture [Pls. 14(1), (2)]. Locally *Amphipora* is present [Alwinsal Loyola 4 32 34 21(W2)]. The bituminous carbonate is commonly overlain by algal stromatolites or algal mats [Pls. 13(3), (4)] composed of rhombs of dolomite. In turn, they are succeeded by interbedded or intermingled cryptocrystalline pale buff dolomite and anhydrite [Pls. 15(1), (2)]. The dolomite is typically sucrosic, comprising rhombic crystals up to 50μm [Pl. 15(3)]. The anhydrite rarely exceeds a thickness of 10 ft (3 m) and occurs as bluish to blue-grey nodular or laminated felted masses which are locally distorted [Pls. 15(3), (4)]. Whereas the interbedded dolomite is typically cryptocrystalline [Pl. 16(1)], there is local sucrosic pale brown dolomite [Pl. 16(2)]. In the latter the greater porosity provided by the relatively large dolomite crystals is plugged by halite.

The felted, tightly-packed laths characteristic of the anhydrite are clearly defined under the SEM [Pls. 16(3), (4)], which shows the dense, non-porous nature of the rock.

In regions where the Hubbard Halite is absent, the interlaminated anhydrite and buff dolomite are succeeded abruptly by anhydrite interbedded with reddish, greenish or grey dolomitic mudstone of the transition zone into the First Red Bed.

Halite in the Neely Member occurs mainly at the top. It is, without exception, secondary and may be displacive or replacive. Rarely it occurs as amber fibrous bands up to 5 cm thick [Pl. 17(1)] which are clearly displacive: clasts of dolomitic mudstone, wedged away from the surrounding sediment after it became lithified, are now "floating" within the halite band. Displacive halite under the microscope [Pl. 17(2)] shows an abundance of particles and fragments enclosed by halite, and subvertical cleavage and fracture traces.

Locally, halite has severely disrupted the carbonate by wedging it apart in many directions [Pl. 17(3)] leaving tapered fractures filled with halite. Where the carbonate was sufficiently plastic at the time of halite precipitation, well-developed displacive chevron crystals have formed [Pl. 17(4)].

Replacive halite occurs filling pores, vugs, and fractures in lithified carbonate. Algal dolomites near the top of the member commonly contain large pores and vugs [Pl. 18(1)] which are commonly infilled with halite. The aragonite shells of gastropods locally are preferentially dissolved and their moulds filled with halite [Pls. 18(2), (3)].

In the northwestern part of the study area clear crystalline gypsum fills large vugs [Pl. 18(4)]. It is similar in appearance to halite-filled vugs elsewhere: the vugs are lined with sucrosic pale brown dolomite, and have an irregular morphology, indicating that they formed in lithified carbonate and were later infilled, rather than developed as crystals in a soft carbonate mush. In view of the general abundance of halite, and the similarity of these vugs to halite-filled vugs, it is considered that they were first filled with halite which was later flushed out and replaced by gypsum.

Halite of the Hubbard Evaporite

The halite is translucent white, or less commonly transparent. Crystal size varies appreciably, occurring as interlocking cubes up to several centimetres in diameter where free of impurities (e.g. S W P Boulder Lake 5 15 30 23(W2)). Where impurities are present, the crystals tend to be smaller. Thin veneers of white to buff sediment are composed of cryptocrystalline dolomite and laths of anhydrite [Pl. 17(2)]. Streaked bands and pockets of dolomitic mudstone may be green or red, and locally are interbedded with translucent halite (Kerr McGee Esk 8 20 33 20(W2)). These alternating halite mudstone sequences are interpreted as shore margin deposits of the Hubbard Evaporite sea.

DEPOSITIONAL HISTORY

Dawson Bay sedimentation commenced upon salt beds hundreds of metres thick covered with a veneer of residual dolomitic mud, extending for thousands of square kilometres uninterrupted by topographic relief. Early Dawson Bay sediments were devoid of fossils, but were probably marine and highly saline due to the nature of the substrate. The marine transgression was probably from the north or east under hot arid conditions, causing slight erosion of the Prairie Evaporite as the waters became supersaturated with halite. Primary dolomite precipitated under these conditions and locally intermingled with underlying salts before the mud veneer became thick enough to seal the salt. When this was established the sea water returned to normal salinity, so that by the end of Second Red Bed deposition restricted fauna, in the form of tiny ostracods, entered the basin. Thin depositional laminae near the top of the Second Red Bed became partially lithified as sedimentation slowed, but were disrupted, perhaps by storms, to form intraformational breccias [e.g. Pl. 4(3)]. Sedimentation finally ceased, and there was a hiatus prior to deposition of the Burr carbonates. Minor silicification took place, a veneer of detritus-free organic material was deposited, and locally a halite bed, less than 1 cm thick, was precipitated. A minor angular unconformity attests to tectonic disturbance, perhaps the result of a widespread removal of the upper beds of the Prairie Evaporite, which caused the partially lithified Second Red Bed to drape the undulating low relief of the underlying salt. Consequently, minor angular discordance can be seen between the Second Red Bed and Burr Members in wells drilled through the slopes of an undulation, whereas those drilled on the crests show little or none.

Sedimentation recommenced with the deposition of alternating laminae of calcite and bituminous material at the base of the Burr Member. This short phase was succeeded by slight deepening of the seas during which more carbonate was precipitated, and soft-bodied organisms burrowed and extensively churned the sediments. The sediments became progressively more calcareous, and a biota representative of normal marine conditions prevailed. The fossil record includes abundant pelmatozoan ossicles, corals, brachiopods, bryozoans and calcispheres. The ostracods indicate an eastern influence during deposition of sediments comprising the Burr Member (Matthieson, *pers. comm.*).

Cyclical sedimentation in the Burr Member is evident from the occurrence of up to 25 hardgrounds. The fauna and sediments indicate that within each cycle normal marine conditions became increasingly restricted, and sedimentation ceased. The sediments developed a black rind at the surface, and became sufficiently lithified for them to be burrowed and eroded or corroded without the burrow walls slumping (Frontispiece). Emergence may have taken place during lithification of some of the hardgrounds, as evidenced by 1) apparent erosion of some beds, notably at the contact between the Burr and Neely Members; and 2) the 'annealed' texture of carbonate grains beneath the hardgrounds. Longman and Mench (1978, p. 249) ascribe similar rounded grain textures to tidal-flat deposits, where continued flushing by relatively fresh water has caused penecontemporaneous recrystallization and homogenization of micrite grains. An alternative and preferred explanation is that the surfaces were corroded by bottom currents, which may have periodically changed direction, perhaps due to alternating influences from the east and west.

Neely sedimentation commenced with an influx of argillaceous lime mud probably from the west (according to evidence from the ostracods). As the clastic component waned a macrofauna different from that of the Burr Member became established and purer lime muds precipitated, probably in deeper waters. The large thin-shelled brachiopod *Stringocephalus* lived during middle Neely deposition among stromatoporoid reefs or banks in the quiet waters.

Shallowing seas restricted the fauna to ostracods and small gastropods living in pelleted lime muds, and eventually gave rise to algal stromatolites and mats as the last vestiges of Dawson Bay life. There is evidence that emergence took place at this time: in the type well of the Neely Member (Lsd. 16-21-34-27W2) a mixture of greyish anhydritic sediment, 30 cm thick, occurs within buff microcrystalline limestone. At the base of this unit is an eroded stromatoporoid overlain by a veneer of black organic residue. At the top is another erosion surface, but eroded from *below* [Pl. 19(1)]; this is evident from the irregular surface basal to the overlying stratified carbonates which have apparently foundered into the underlying sediment. The grey sediment is interpreted as a cave deposit. The sequence of events which led to its formation are illustrated in figure 8. The environment envisaged is akin to that of the Bahamas where shallow waters extend for many square kilometres and periodic emergence and phreatic flushing of carbonate banks takes place, giving rise to some carbonate dissolution.

The final stage of deposition was one of calcium sulphate precipitation interspersed with thin accumulations of greyish-green dolomitic mud. Conditions became comparable to the modern sabkha environment of the Persian Gulf. The marine basin was slightly deeper in the southeastern part of the study area, so that the last of the sea dried up there after depositing the Hubbard halite and interbedded dolomitic muds (Fig. 3).

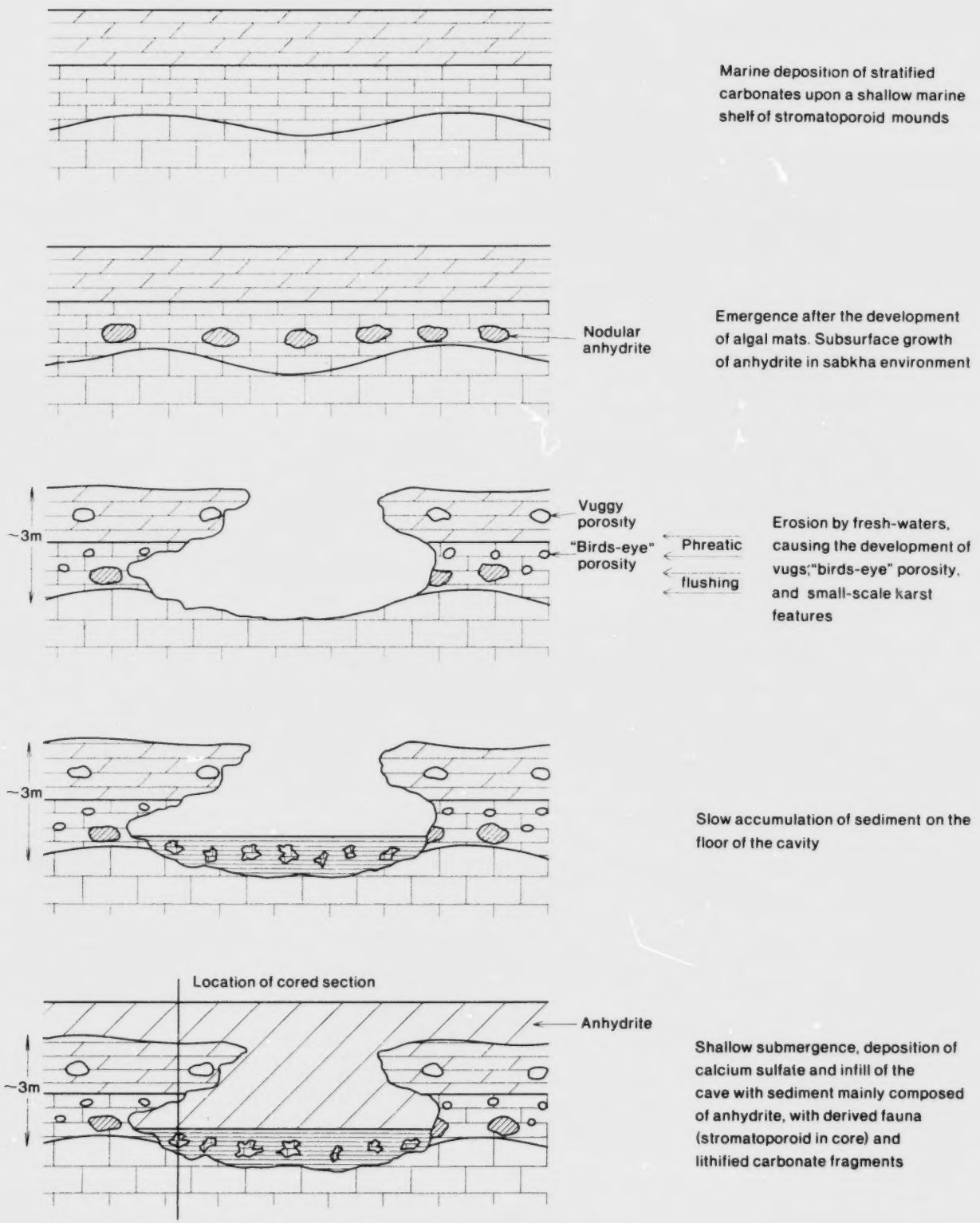

Marine deposition of stratified carbonates upon a shallow marine shelf of stromatoporoid mounds
Nodular anhydrite
Emergence after the development of algal mats. Subsurface growth of anhydrite in sabkha environment
~3m
Vuggy porosity
"Birds-eye" porosity
Phreatic
flushing
Erosion by fresh-waters, causing the development of vugs;"birds-eye" porosity, and small-scale karst features
~3m
Slow accumulation of sediment on the floor of the cavity
Location of cored section
Anhydrite
~3m
Shallow submergence, deposition of calcium sulfate and infill of the cave with sediment mainly composed of anhydrite, with derived fauna (stromatoporoid in core) and lithified carbonate fragments

Fig. 8: Sequence of Events Leading to the Development of a Small Cave Deposit — Noranda Neely 16 21 34 27W2

STRUCTURE

Fractures

Fractures are commonly encountered in the cores. Their orientations are mostly vertical to sub-vertical (90-70 degrees) (Pl. 19). Where the carbonates are cryptocrystalline and porcellanous, hair-line cracks are locally present which tend to terminate at the upper contact with less competent microcrystalline carbonates [Pls. 6(2), (3), and 7(3)]. Additional hair-line cracks in halite are seen in thin section [Pl. 20(1)]. In the uppermost carbonates of the Neely Member there are tiny wedge-shaped cracks which are attributable to desiccation during periods of tidal-flat emergence [Pl. 20(2)].

In regions where salts of the Prairie Evaporite have been dissolved, fracturing of Dawson Bay carbonates is prevalent, and the fractures are often wedged apart by the later introduction of clear halite (Pl. 19). In the Continental Potash Arelee 7 4 38 11(W3) well, one such fracture is filled with an 8 cm-wide band of coarsely crystalline clear halite. The sediments of the Dawson Bay Formation in the latter well are extensively fractured and tilted due to their subsidence into a salt-solution cavity, with the result that: a) beds dip from 15 to 30 degrees; b) abundant fractures range in dip from 20 to 90 degrees; c) some crinoidal limestone shows vertical strain marks.

The poorly consolidated nature of the Second Red Bed dolomitic mudstones renders them readily susceptible to fracturing and wedging apart by halite, precipitated from supersaturated brine solutions migrating upward from the underlying salts. This halite is usually fibrous and orange, and forms veinlets from 2 to 20 mm wide [e.g. Kennco 3 Prudhomme 12 10 38 28(W2); Kennco 2-Young 15 36 32 29(W2); Goldfield Grt Cdn Dundurn 10 7 32 5(W3); Noranda Neely 16 21 34 27(W2)]. Locally, slickensided surfaces are present in the Second Red Bed [e.g. Kerr-McGee Horseshoe 16 36 30 28(W2)].

It appears that from observations made of many cored sections, fracture patterns are dominantly near vertical, and that tectonism has virtually no lateral component. Fractures can be attributed entirely to subsidence of Dawson Bay strata into cavities formed by local solutioning of the Prairie Evaporite. In that many cored sections exhibit fracturing, and the cores represent a miniscule fraction of the 24,000 km^2 study area, fracturing of the Dawson Bay carbonates must be the rule rather than the exception, and extensive fracturing can be expected in every area that has suffered salt-solutioning. Fortunately for potash mine operations, fractures are commonly sealed by halite (or occasionally anhydrite), so that large areas of water-free Dawson Bay rocks still exist.

Major Solution Features

A structural surface map of the Dawson Bay Formation (Fig. 9) shows a gentle regional dip of about 20 ft/mile (4m/km) toward the south and southwest. Considerable local relief is superimposed upon this regional trend. The area is broadly divisible into an eastern region (east of Saskatoon), where distinct east to northeast trending structural "lows" occur, and a western region where the structural grain is less clearly defined and follows a more northerly trend. In the southwest, closely spaced contours reflect part of the "Rosetown low": a circular depression attributed to salt solutioning of the Prairie Evaporite (De Mille *et al.*, 1964).

It was shown earlier that the monotonous lateral extent of facies and the uniform thickness of the Dawson Bay sediments can be interpreted as reflecting sedimentation on a broad shallow marine shelf. Consequently, the appreciable structural relief (Fig. 9) must be a result of local subsidence post-dating Dawson Bay deposition. The process most likely to be responsible is that of salt solutioning. Structural "lows" on the Dawson Bay surface coincide with a reduction in the thickness of the Prairie Evaporite. This observation has been discussed in numerous publications (e.g. Bishop, 1953; Walker, 1956, 1957; Christopher, 1961; De Mille *et al.*, 1964; Anderson and Hunt, 1964; Holter, 1969; Bishop, 1974). Overlying strata have foundered into these solution 'sinks', often forming breccias [Pl. 21(1)] composed of fragments of Dawson Bay and Souris River carbonate rocks set in a reddish matrix of dolomitic mudstone. The structure contour interpretation illustrated in figure 9 implies that there is a large salt-solution depression to the south and east of Saskatoon. The Southwest No. 2 well (Lsd. 16-32-36-4W3) confirms the absence of Prairie Evaporite salts: brecciated dolomitic mudstone containing clasts of carbonate and anhydrite constitutes the Second Red Bed, which rests upon anhydrite of the Prairie Evaporite or Winnipegosis Formation. Farther to the east there is a prominent solution channel near Watrous (Tp 31, R 25W2) which trends north-east. It is probably connected to the Venn Low (Tp 29, R 24W2 to Tp 25, R 24W2) but strikes in a markedly different direction (cf. Bishop, 1954; Holter, 1969). West of Saskatoon there is another structural low near Arelee (Tp 38, R 11W3): a well there has proven the Dawson Bay to be severely fractured but halite plugged [Continental Potash Arelee 7 4 38 11(W3)]. Tilting is also evident here in that two hardgrounds at the top of the Burr Member dip 20 to 30 degrees. The well terminates in the Second Red Bed, so it is not known if the Prairie Evaporite is present. However, 14 km to the southeast there is a structural low [C. M. and S. Asquith 1 4 37 10(W3)] where brecciated red dolomitic mudstone of the Second Red Bed rests upon halite with carnallitic residue, of the Prairie Evaporite. Thus, this area has undergone salt

solutioning. It is the writer's surmise that in the area around Township 36, Range 11 (W3) the Prairie salt is absent (Fig. 9).

An unusual feature was brought to the author's attention by G. McVittie of Cominco Ltd., and is worthy of discussion in that it has extensive implications for interpretation of the solution history of the Prairie Evaporite, and early recognition by mine geologists of their approach to such features could save considerable time and cost of mining into 'barren' salt, and possibly into blocks of carbonate.

In the C. M. & S. Vanscoy 4 30 35 8(W3) well, bioturbated limestone lithologically similar to the Burr Member [Pl. 21(2)], occurs beneath 159 ft (48 m) of Prairie halite. Within this region the Prairie Evaporite is generally of the order of 500 ft (150 m) thick. The well terminated 12 ft (4 m) into this limestone, and it appears that this is a large block which fell or slid into a salt-solution cavern some 150 ft (45 m) deep.

The relevant stratigraphic sequence is described below. It is noteworthy that 90 ft (27 m) above the limestone block the clay seams show a shallow dip which increases downward.

C. M. and S. Vanscoy 4 30 35 8
Lsd. 4-30-35-8W3
K.B. 1671 ft (509 m)

Depths in feet (metres)	
	Overlying bed: halite of the Prairie Evaporite
3611 (1100.6)	Clay seams in halite dip at 15°
3655 (1114.0)	Clay seams in halite dip at 20°
3656 (1114.3)	Brecciated band of dolomitic mudstone containing multi-directional fibrous anhydrite after gypsum; base of seam dips at 25°.
3662 (1116.2)	Vestigial bedding in halite dipping 35°.
3669 (1118.3)	Vestigial bedding in halite dipping 45°.
3676 (1120.4)	Severely brecciated band of dolomitic mudstone containing fibrous anhydrite after gypsum; dip at 45°.
3698 (1127.2)	Clear interlocking crystals of halite up to 5 cm in dia. (recrystallized).
3699-3701 (1127.5-1128.1)	Mixture of brecciated dolomitic mudstone and halite overlying carbonate. Contact angle is 50°: no mixing at contact [Pl. 21(2)].
3701-3705 (1128.1-1129.3)	Limestone (Dawson Bay Fm.), dolomitic, microsucrosic, pale brown; bioturbated; strata dip at 65°.
3705-3707 (1129.3-1129.9)	Hardgrounds dipping at 65° [Pl. 21(3)]. Burrowed surfaces overlain by wispy-laminated bituminous limestone. Occasional halite-filled vugs, blebs of bluish anhydrite and pelmatozoan ossicles.
3707-3713 (1129.9-1131.7)	Bioturbated limestone, same as above. Some vestigial hardgrounds. Constant dip throughout of 65°.
3713 (1131.7)	Bottom of cored section.

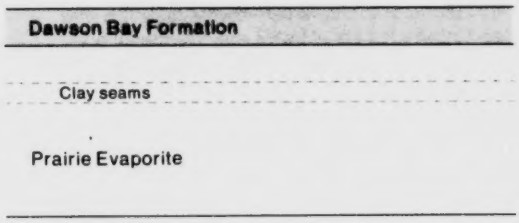
Bedding features, notably two prominent hardgrounds [e.g. Pl. 21(3)], show that the block is not overturned, and that it is resting at an angle of 65 degrees. It is probably "floating" in halite: had drilling continued through the carbonate it is likely that more halite of the Prairie Evaporite would have been encountered. A sequence of events which may have brought about this phenomenon is suggested in figure 10.

Salt-solutioning may have been triggered by deep crustal movements, which were transmitted as moderate earth tremors to give rise to fractures along which formation waters, undersaturated with salt, could have migrated and locally dissolved the Prairie Evaporite at the contact with the Second Red Beds. The latter sediments although well compacted, could have acted as an aquifer because they comprise the first beds above the salt that are weak, susceptible to fracturing and therefore relatively permeable. An analogous situation has been observed by the author in the Cory mine. There water emerges from the base of a red dolomitic clay seam within the Prairie Evaporite.

A difficulty posed by this scenario is the requirement for the removal of sufficient salt in order to form a cavern of the size envisaged. It is proposed that constant flushing of the cavity by relatively fresh waters could create a cavern of this size before creep and collapse took place. Even today, when the overlying sedimentary pile is three times thicker than during the Upper Devonian when solutioning took place, drillers occasionally report substantial lost circulation at the Second Red Bed/Prairie Evaporite contact, thereby indicating the existence of cavities.

An alternative explanation is that salt-solutioning occurred at the base of the Prairie Evaporite. Gendzwill (1978) suggests that water moving through carbonate mounds of the underlying Winnipegosis Formation, removed adjacent Prairie Evaporite salt thereby causing subsidence of overlying strata. He determined that depressions up to 100 ft (30 m) deep in the overlying beds occur above the mounds. Given this situation the salt beds would have creeped to fill the cavity, and their displacement would have been transmitted through the Prairie Evaporite, thereby giving rise to a cavern at the top of the formation. A strong beam of Dawson Bay carbonates could have supported the overlying sedimentary column for a period of time before expansion of the cavern exceeded the critical span for splintering and collapse to have taken place. Thus, the sequence of events would have been the same as that illustrated in figure 10, except that solution was from the base of the Prairie Evaporite rather than the top. It is regrettable that the Vanscoy 4-30 well did not penetrate

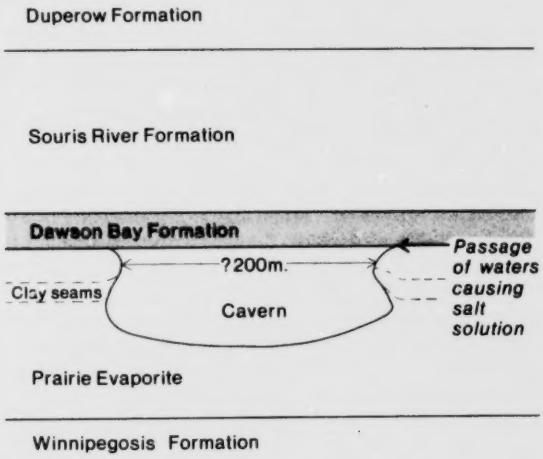
1.



Middle Devonian

Sequence of sediments prior to disruption

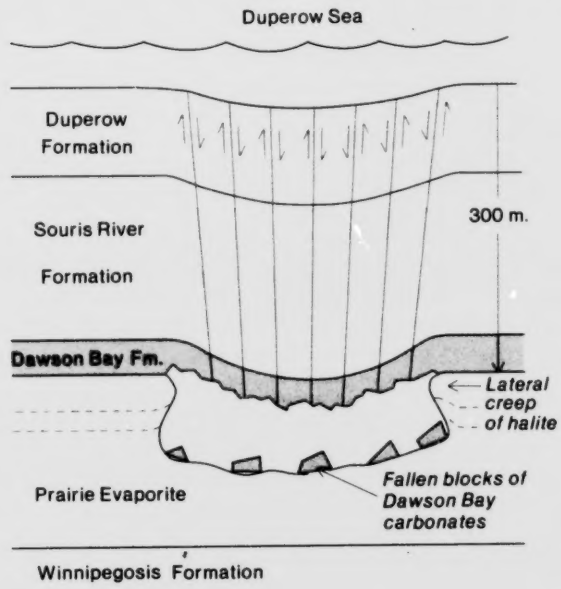
2.



Upper Devonian (Early Duperow)

Developement of cavern (? several hundred metres in diameter by about 50 m. deep) through solutioning by migration of water along the Second Red Bed/Prairie Evaporite contact

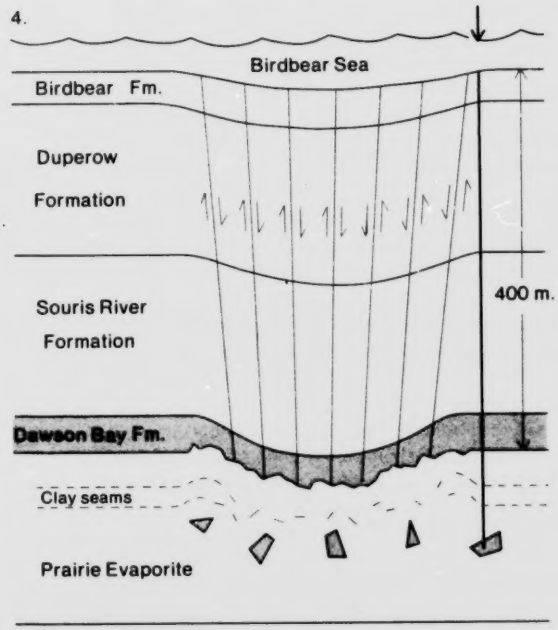
3.



Upper Devonian (Middle Duperow)

Lithostatic pressure caused buckling of the Dawson Bay, then near vertical fracturing, and foundering of Burr Member blocks into the cavern. Contemporaneous subsidence of overlying Devonian carbonates resulted in local thickening of sediments during the middle Duperow (Wymark Member)

4.



Upper Devonian (Upper Birdbear)

Second period of subsidence during deposition of upper Birdbear carbonates, as cavity was finally filled by further downwarping and near vertical fracturing. Arrow indicates location of well at Lsd. 4-30-35-8W3

Fig. 10: Sequence of Events Leading to the Preservation of Dawson Bay Carbonates within the Prairie Evaporite

to the underside of the block of Dawson Bay carbonate, for then it might be possible to determine which of the above processes is the more likely: if the stratigraphic sequence beneath the carbonate block is undisturbed, then solutioning from above is the more likely; if disturbance is evident then solutioning from below seems the answer.

Another possible factor should be mentioned; namely that of carnallite as a water source, if that mineral was the original potassium precipitate. As carnallite alters to sylvite there is a release of Mg-rich waters and a volume reduction of about twenty percent; thus a cavity could have developed as water left the system. However, if this were the case some sylvite should remain, but no Patience Lake Member (i.e. no potash) is present at this location. Furthermore, such de-watering of carnallite might be expected to give rise to many similar features throughout central Saskatchewan but they are a rarity.

The time of the salt-solutioning can be ascertained from examination of the geophysical well-logs from the anomalous and neighbouring wells. The structural low at this locality (Fig. 9) is 70 to 80 ft (21-24 m) lower than would be expected from the regional trend, and the Duperow and Birdbear sediments are relatively thick. The implications are that subsidence (i.e. foundering of strata into the solution-cavern) took place at several times during the Upper Devonian. By middle Duperow time there were about 1000 ft (300 m) of carbonates above the Prairie Evaporite. Events related to salt-solutioning also took place elsewhere in southeastern Saskatchewan during Duperow times (cf. Dunn, 1975b).

By analogy with the Wink Sink in Texas, the solution hollow may well have been circular, and up to 650 ft (200 m) in diameter. The Wink Sink (Geotimes, Sept. 1980, p. 16, 17) is a circular feature 360 ft (110 m) in diameter, which developed within 2 days in June 1980. It is attributed to collapse into a solution cavern of the Permian Salado Formation. It is noteworthy that the Salado Formation occurs at depths ranging from 1000 to 1400 ft (300 to 425 m), because it appears that the cover of Devonian carbonates in Saskatchewan was of similar thickness when solutioning and collapse took place. Dawson Bay carbonates are strong (see section on Rock Mechanics) and therefore could act as a beam, beneath which a cavern possibly of greater dimensions than the Wink Sink could develop before reaching the critical point at which the roof of the cavern would weaken and collapse. Furthermore, the highly competent nature of the Dawson Bay carbonates would permit the rocks to fracture into large blocks (perhaps tens of metres across) which would founder into the cavern. The incompetent nature of the Prairie Evaporite salts under high differential lithostatic pressure, would cause them to flow into any remaining void, and thus overlie the younger blocks of Dawson Bay strata. Flow structures, dipping clay seams, brecciated dolomitic mudstone, and recrystallized large crystals of transparent halite all bear witness to the remobilization of the Prairie Evaporite.

From the above discussions and observations of salt solution features it is concluded that: 1) large solution caverns (several hundred metres in diameter) probably develop at a rate which does not provide sufficient time for halite to flow laterally into the void, hence overlying carbonates of the Dawson Bay Formation develop vertical fractures due to the weight of the overburden, and founder into the cavity. These rocks, due to their brittle nature, splinter into fragments ranging in size from a few centimetres to tens of metres, and possibly larger; 2) smaller solution features may result in some bending of the overlying carbonates with or without the development of sufficient fracturing to permit blocks to founder into the cavity. Given the latter eventuality, Prairie Evaporite salt may creep laterally over the foundered blocks and show signs of brecciation, recrystallization and dipping clay seams. By examining structure contour maps of overlying formations, it becomes possible to ascertain (from locally thick sections) the time that solutioning and subsidence took place. There are indications that the Upper Devonian (Duperow and Birdbear) was a time of widespread occurrence of salt-solutioning. (cf. Bishop, 1953; Christopher, 1961; Nichols, 1970; Dunn, 1975b).

The ultimate control of salt-solutioning events may be basement movements which cause fracturing, and create new pathways for the passage of formation waters to dissolve salts. Little is known of the basement configuration within the study area, because only seven wells penetrate the Precambrian. This provides only enough data to show the regional dip of the Precambrian surface to be toward the southwest (Paterson, 1975). Gravity survey compilations indicate northerly trends (Sask. Dept. Min. Res. Files), with a circular structure of relatively high gravity occurring to the east and north of Saskatoon. Gravity relief across the area is about 20 milligals.

Figure 11 is an objective mathematical approach to the representation of structure contours on top of the Dawson Bay Formation. The basic pattern is the same as that interpreted by the writer (Fig. 9), but trends in the latter are somewhat intuitive (based upon all the available geological information). Trends on the computer plot are less clearly defined and the approach has drawbacks in that there is a tendency for contours, where extrapolated into areas with no well control, to show anomalous structures for which there is no proof: interpretation of the patterns must therefore be treated with caution. Points in favour of including the computer-plotted map are: 1) it represents an alternative interpretation of the data without the writer's bias; and 2) it is useful as the basis for a trend surface analysis.

Trend Surface Analysis

This mathematical technique seeks to obtain the best fit of a set of data points to a surface. It is used to separate regional trends from local variations. In this study plots were made of the first, second, and third degree surfaces, and the last provides the closest regional fit (i.e. average surface) to the structure contours. Depths to the true Dawson Bay top will, of course, vary above and below this average surface, and these 'residuals' can themselves be contoured. The result is a map with positive and negative features which can be visualized as representing 'hills' and 'valleys' upon a regionally flattened Dawson Bay surface (Fig. 12). Noteworthy features upon the map are the 'valleys': The Rosetown low, the Saskatoon low, the Arelee low, and the Watrous low: all these features can be discerned on the structure contour map, but the trend surface analysis helps to depict their presence and extent more clearly, as well as their amplitudes.

In order to demonstrate how closely the Dawson Bay strata have been controlled by Prairie Evaporite diagenetic events a map is plotted of the third degree residuals from a trend surface analysis of the top of the Prairie Evaporite (Fig. 13). The remarkably close similarity between the two maps serves to emphasize the uniform "blanket" nature of the Dawson Bay Formation and, in a structural sense, its total reliance upon dissolution of the Prairie Evaporite.

Relationship of the Dawson Bay to the Potash Beds

An indication of regions in which partial salt-solutioning has occurred can be obtained from consideration of the thickness of halite ('salt-back') above the potash, when this information is used in conjunction with structure contour (Fig. 9) and isopach (Fig. 3) maps. Within the study area potash ore is being extracted only from the Patience Lake Member (the uppermost of the three main Prairie Evaporite potash members). Areas of major salt-solutioning are shown on figure 14, along with thicknesses of the salts which occupy the interval between the base of the Second Red Bed and the uppermost prominent potash bed of the Patience Lake Member (i.e. the lithostratigraphic top as opposed to the temporal top of the member). Before discussion of the map it is important to amplify the reasons for choosing this interval as the salt-back.

The term 'salt-back' conveys a different meaning to a mine operator in one area from that in another, because the potash is being extracted from different stratigraphic levels within the Patience Lake Member. The member is defined (Holter, 1969, p. 23 and Fig. 16) as the strata between 3260 feet and 3333 feet (994 and 1016 m) in the Elstow 16 9 well (Lsd. 16-9-35-1W3). Throughout much of the study area the top of the member is well-defined, in that the uppermost prominent potash bed constitutes the upper limit to the Patience Lake Member, and gives rise to a strong positive deflection of the gamma-ray log curve.

From Holter's (*op. cit.*) description, it seems that the Patience Lake Member constitutes only that sequence of beds which contains potash: time-equivalent strata of halite are deemed not to be part of the member, consequently there is considerable local variation in the thickness of the member due to either non-deposition, erosion, or solutioning of the potash beds. The Elstow 16 9 type section is a location where the potash sequence is particularly well developed in that the member is 73 ft (22 m) thick, and has a well-developed uppermost potash bed which is absent from many locations across the study area. As a result, the salt-back to the Elstow 16 9 type section is recorded as 25 ft (7.6 m), whereas that in a neighbouring well, Altair Elstow 15 24 (Lsd. 15-24-34-1W3) is recorded as 41 ft (12.5 m) because the uppermost potash bed is absent. Thus from one location to the next the salt-back map is recording either:

1. the salt-back to the fully-developed Patience Lake Member; or

2. the salt-back to a horizon lower in the stratigraphic sequence — i.e. the uppermost well-developed potash bed of the Patience Lake Member, whether it results from non-deposition, solutioning of salts, or erosion.

It is difficult (and often impossible) to define the time-equivalent top of the Patience Lake Member from the gamma-ray log. Neutron-logs help in some cases, but are seldom definitive. The logs of three wells located a few kilometres west of Saskatoon (Fig. 15) demonstrate the situation. Log A shows a typical well-developed sequence of potash beds, arbitrarily numbered 1 to 8, which constitute the Patience Lake Member. Five kilometres away (log B) beds 1 to 4 are similar, but beds 5 to 8 are absent. A farther 10 km distant all but the uppermost of the eight beds are present. The neutron logs do show similar patterns in all three wells, so that it is possible to identify in log B a time-equivalent top to the Patience Lake Member, despite the absence of the potash beds. However, because the Patience Lake Member is defined as a potash-bearing sequence, its top in log B must be taken at the top of potash bed number four.

It would be of use to map the interval between the Second Red Bed Member and the time-equivalent top of the Patience Lake Member (perhaps a 'shale marker') in order to examine these variations in the thickness of the halite. Unfortunately, there is a high degree of uncertainty as to where to pick this top in many of the neutron logs. Conversely, the gamma-ray log may be misread in the absence of the neutron log. For example, in log C (Fig.

15) the uppermost prominent gamma-ray deflection (bed 7a) appears to be the same as bed 8 in log A. However, examination of the neutron log shows that a 'shale marker' occurs beneath bed 8 (log A), but above bed 7a (log C), hence bed 8 is missing from the latter well. The error in misinterpreting bed 7a as bed 8 in this case would be 6-7 feet (2 m), but in many wells it could be much greater. In old wells, where only electric logs or imprecise gamma-ray logs are available, it is seldom possible to identify from the curves any of the 'shale markers' that are important to the mining operatons.

For the most part, the salt-back has a regional thickness (Fig. 14) of 20 to 40 ft (6 to 12 m). There are, however, several areas where the salt-back is anomalously thin or absent:

1. North of the zero contour near the top of the map the absence of salt-back is due to pre-Dawson Bay erosion.

2. East of the Central Canada mine (Tp 33 R 27W2), the Patience Lake Member is absent in both the Shell Young 5 31 33 26 (W2) well and the Plunkett No. 1 well (Lsd. 1-15-34-25W2), and probably absent in the Duval Potash Viscount well to the northeast (Lsd. 5-18-34-25W2). The latter is an old well with no logs beneath the Souris River. No potash is recorded from cores taken in the upper 71 ft (21 m) of the Prairie Evaporite, at which depth the well was abandoned. A structural low (Fig. 9) in this vicinity indicates an area of subsidence attributable to salt-solutioning. There is also a corresponding seismic low (Fig. 16).

3. Southwest of the Lanigan mine, across ranges 24 and 25 (Tp 32 W2) the salt-back thins to less than 10 ft (3 m), and there is a coincident northeast-trending structural and seismic low.

4. Northeast from the Allan mine (Tps 35 and 36, R 27 and 28 W2) is a less well-defined region of salt-back thinning, which can be traced westward along Tp 35 to the negative salt-solution feature (Fig. 9) which dominates the map. The inference is that partial solutioning of the uppermost halite of the Prairie Evaporite has occurred, perhaps due to downward erosion by the passage of formation waters along the contact with the Second Red Bed Member. This process has subsequently been halted here due to the precipitation of halite in pore spaces of the Dawson Bay sediments, and waters have been forced to seek new pathways.

5. North of the Cominco mine, in Tp 37 R 8W3, the salt-back is only 8 ft (2.4 m) thick in one well. It may be that contours at this site should be connected to the region of thin salt-back to the east, and that partial solutioning of the uppermost salts has extended from here to the region of major solutioning farther east.

6. Close to the Cominco mine the Patience Lake Member is locally absent (Lsd. 4-30-35-8W3). It appears that localized solutioning has taken place, followed by subsidence of the overlying strata. The Dawson Bay Formation is about 100 ft (30 m) lower (Fig. 9) here than would be expected from the regional trends.

Locally, the salt-back is unusually thick (sites marked A to H, Fig. 14). These features are due either to non-deposition of some potash beds, or local solutioning of the potash followed by infill of the resultant cavity by lateral creep of halite, with or without some halite recrystallization. It is considered probable that the area of salt solutioning inferred at sites B and C is continuous with the region a few kilometres to the east where the Patience Lake Member is absent. Had a slightly thicker sequence of salts been dissolved from sites B and C they, too, would have no Patience Lake Member present. As it is, both sites show thinning of Patience Lake potash, presumably as a result of post-burial salt-solutioning.

At site E (Fig. 14) it appears that the upper beds of potash have been dissolved and replaced by halite, and a similar situation holds for sites F, G and H.

In conclusion, it is the writer's interpretation that variations in thickness of the salt-back can be attributed to:

1. local non-deposition of the uppermost bed of potash in the Patience Lake Member, with halite precipitating in its stead. Such features can be identified by local thickening of the salt-back by about 10-20 ft (3-6 m);

2. local solutioning of potash beds after burial, and subsequent infill of the cavity by lateral creep of halite, with or without recrystallization of halite. These features appear as more pronounced local thickening of salt-back (greater than 30 ft — 9 m), or local absence of the Patience Lake Member;

3. local post-burial partial solutioning of the uppermost halite strata by the passage of formation waters at or near the base of the Second Red Bed Member. These features are recognized by relatively thin salt-back associated with structurally low Dawson Bay strata.

FORMATION FLUIDS

Distribution

No hydrocarbon shows have been reported from the Dawson Bay Formation in the study area. Kerogenous matter is present as a veneer at the top of the Second Red Bed, and in the uppermost carbonates of the Neely Member within which bituminous halite also occurs. The chance of encountering pockets of hydrocarbons within the lowermost 100 ft (30 m) of the formation is extremely remote. In the upper Neely Member conditions are more favourable in that banks or shallow reefs of stromatoporoids are present [e.g. Goldfield Dundurn 10 7 37 5(W3)]. However, over a large part of the study area porosity of the Dawson Bay strata is plugged with halite. This was demonstrated by Lane (1959, Fig. 10) and re-evaluated in the light of new drill-stem-test (DST) data by Dunn (1975a, 1976). Recoveries from 159 DSTs in 130 wells yielded either clean mud, salt water or mud-cut-salt water. Many tests straddle much of the Dawson Bay Formation and part of the overlying Souris River Formation, so that it is not always possible to determine which stratigraphic interval is water-bearing. Figure 16 summarizes DST recoveries, and boundaries are drawn to delineate the probable extent of water-bearing Dawson Bay strata. Data used for plotting the map are given in Appendix III. The numerous "clean mud" recoveries attest to the general lack of Dawson Bay permeability and porosity in this region, although locally, considerable yields of salty mud have been recovered [e.g. 930 ft (283 m): White Rose et al Trojan 16 36 36 28(W2)].

In several wells narrow-range DSTs show the Burr Member to be "dry", whereas the Neely Member is water-bearing (e.g. PCA Saskatoon No 10, Lsd. 4-4-37-3W3). This is in part due to the generally larger size of carbonate crystals in the Neely Member, hence greater porosity and permeability [cf. Pl. 8(1), (2) and Pl. 11(3), (4)].

The data interpretation depicted in Figure 16 shows the potash mines to be situated beneath Dawson Bay strata which contain no fluids: above the southeast corner of the Cory mine (Tp 36, R 6W3) water was recovered from a DST of the Neely Member, but a Burr Member test yielded only clean mud. A similar situation exists above the southern half of the PCA mine (Tp 36, R 3W3). Southeast of the Allan mine 1456 ft (444 m) of salt-water was recovered from a test which straddled the Dawson Bay Formation: it is not known if all or only part of the formation is water-bearing. It is noteworthy that the water-bearing zones generally follow the trend of north or northeasterly-striking seismic lows. These seismic lows are considered to correspond to Prairie Evaporite salt-solution features (cf. Holter, 1969, p. 51), and thus represent channelways that, having been flushed by formation waters, have remained water-bearing.

Based upon the above relationship, the dashed outline of the 'dry' Dawson Bay regions (Fig. 16) is extended around seismic lows in several places, and represents the author's interpretation of the accumulated data (considering structure contours, seismic evidence, proximity to water-bearing strata and local absence of Prairie Evaporite potash beds). The most notable of these areas occurs to the east of the Central Canada mine where there is a structural low (Fig. 9), seismic low (Fig. 16), local absence of the Patience Lake potash, and salt-water (1380 ft [420 m]) recovered from lower Souris River strata in the Duval Potash Viscount well (Lsd. 5-18-34-25W2). At other locations where seismic lows occur, evidence of water-bearing Dawson Bay strata is less conclusive, thus a question mark is put on the map. It seems likely that water may be expected in these regions.

In the northwestern corner of the Central Canada mine, water from the Dawson Bay is seeping into the mine. Recent drilling upward into the Dawson Bay has shown that water is flowing horizontally along the unconformity between the Second Red Bed and Burr Members [see point 'a' on Plate 1(2)] and also along sub-vertical fractures in the Burr Member (which has all other potential porosity plugged by halite). The flow along the unconformity could have commenced recently as a result of release of hydrostatic stress by creep of the potash-halite walls toward the mining galleries: the unconformity is a potential plane of décollement within the Dawson Bay Formation. Differential stress can also be invoked to explain the opening of the vertical fractures, and subsequent tapping of the water-bearing sediments which lie a short distance to the west (Fig. 16). Similarly, as noted in the discussion of major solution features, within the Prairie Evaporite water in the Cory mine is seen to flow along the contact between dolomitic mudstone bands and underlying salts. As indicated earlier, on the basis of this observation it may be that the contact between the Second Red Bed and the Prairie Evaporite is a horizon of preferential flow of formation fluids, whether they be regional flows or connate pockets.

In the potash mines, local water seeps appear which bear no discernible relationship to formation fluids from the Dawson Bay Formation. Many of these seeps undergo a cycle of increasing flow which gradually ceases leaving only stalactites and stalagmites of halite as evidence of their presence. They are considered to originate from pockets of connate brine.

Figure 17 is a potentiometric surface map, calculated from the few Dawson Bay drill-stem tests. In general, pressures decrease toward the northeast. Values are closely comparable to those recorded from the Mannville (Christopher, 1980) indicating that formation

waters in the Cretaceous and the Paleozoic are in continuum. Impermeable strata are present in the Paleozoic, but regions of salt solutioning (Fig. 17), with associated brecciation and vertical fracturing, have brought Dawson Bay strata into contact with those of the Winnipegosis and permitted the upward passage of formation waters in volumes great enough to maintain a regional water-pressure system from below the Dawson Bay (probably from the Silurian) to the Cretaceous (Christopher, 1974, p. 121).

To the southwest of Saskatoon, the potentiometric surface rises to near 600 m (Fig. 17), suggesting the possible presence of a small potentiometric cell. The indications are that there is a local increase in the pressure gradient. Similarly, east of Saskatoon (Tp 36, R 3W3) relatively close contour spacing indicates another region of local increase in water pressure.

Chemistry

There is record of only five analyses of fluids recovered from the Dawson Bay Formation in the study area (Table 3). All fluids are highly saline, with that farthest to the northeast containing the least amount of salt. The waters are slightly alkaline (pH 7.4 to 7.8) and exhibit a wide variation in the amounts of dissolved Ca^{2+}, Mg^{2+}, and sulphate, which no doubt were derived from dissolution of limestone, dolomite and anhydrite as formation waters migrated toward the northeast.

The low ratio of (Na^++K^+) to Cl^- (0.6, except for the well at 4-2-32-25W2) suggests that the waters may be residual to the precipitation of the secondary halite that plugs the Dawson Bay porosity: these tests were all taken within the Neely Member. The relatively high ratio of total dissolved solids (mainly Na^++K^+) to Cl^- in the remaining well is consistent with waters which owe their salinities to dissolution of primary evaporites (Na^++K^+ salts): these waters were recovered from lower in the Dawson Bay sequence than the others, and could well be derived from dissolved primary salts of the Prairie Evaporite.

Additional information supplied with the analyses is that iron is "absent" in the 6-16-38-1W3 well, and "present" in the 16-24-39-4W3 well; carbonate is recorded only from the Neely/Burr test (70 ppm) in the 4-2-32-25W2 well.

		Ion Concentrations in ppm						
Location	Dawson Bay Member	$Na^+ + K^+$	Ca^{2+}	Mg^{2+}	SO_4^{2-}	Cl^-	HCO_3^-	pH
15-14-40-20W2	Neely	48,742	2,260	630	6,800	75,880	153	7.8
4-2-32-25W2	Burr + 2nd Red	166,000*	2,010	375	6,430	95,000	240	n.d.
4-2-32-25W2	Neely + Burr	123,000*	1,280	265	11,400	64,000	250	n.d.
6-16-38-1W3	Neely	116,969	1,510	3481	4,280	190,000	160	7.4
16-24-39-4W3	Neely	110,559	5,340	3067	1,226	188,000	49	7.5

* = Total Solids. n.d. = not determined

TABLE 3: Formation Water Analyses from Drill-Stem-Test Recoveries

MECHANICAL PROPERTIES OF DAWSON BAY ROCKS

Fifteen core samples from three wells were tested to ascertain the compressive strength, tensile strength, and elastic properties of typical Dawson Bay lithologies. This study was initiated by Dr. W. Potts (formerly of the Saskatchewan Dept. of Mineral Resources) who had the tests performed at the University of Saskatchewan. Rock mechanics data used in the following discussion are from an internal report submitted to Dr. Potts by Dr. King (U. of S.). Sample preparation and testing conditions are summarized in Appendix IV.

The wells chosen for study are in the vicinity of the Cory mine (Lsd. 6-18-36-6W3, previously named Duval), and core samples were taken from the Burr and Neely Members. All samples were carbonates (predominantly limestones) except for the upper Neely samples in which anhydrite was the dominant mineral (Table 4). It was reported that all the uniaxial compressive test specimens failed explosively, with signs of prior vertical splitting. The latter could be an indication of the testing conditions, however there is evidence of a natural vertical weakness in the rocks (Pl. 19). Most samples had their pores plugged with halite, and because water was used as the lubricant during sample preparation some halite would have been washed out. As a result a minor degree of sample inhomogeneity was present at the time of testing, perhaps giving rise to slightly lower values than might be expected from an unadulterated rock. It should be noted, too, that in tests of this kind recorded strengths are the result of high loading rates, and may differ considerably from creep strengths. Furthermore the compressive strengths are minimum since they were unconfined tests (i.e. uniaxial and not triaxial).

Average results for each Dawson Bay unit are tabulated below (Table 5).

Observations and comments on the data within Tables 4 and 5 are:

1. Uniaxial compressive strength predicted by the extended Griffiths failure criterion is that the ratio of compressive to tensile strengths should be 12. The average of all results (Table 5) shows that for these rocks the ratio is 13, with the highest (15) occurring in the upper Neely, and the lowest (10.6) in the lower Burr.

2. Sedimentary rocks of the Dawson Bay Formation are of unusually high strength, and are of the moderately high elasticity to be expected (cf. Siegel, 1967, p. 362);

3. Whereas the small number of samples tested is of low statistical significance, the good repeatability of the tests lends weight to the representativeness of the data for the formation as a whole;

4. The relatively low compressive strength of samples from the lower Neely Member is attributed to the presence of diffuse bituminous laminae acting as glide planes. The similar compressive strength values recorded for samples from the lower Burr Member is attributed to the slightly argillaceous nature of the rock samples and their greater porosity than the other samples tested;

5. Upper Burr Member samples exhibit the greatest compressive strengths (up to 0.314 x 10^6 kPa, or 45,600 psi). From Table 4 it is seen that one upper Burr limestone has a relatively low compressive strength (0.155 x 10^6 kPa, or 22,500 psi), and that this sample contained abundant faunal fragments and a hardground; hence planes of weakness were present to account for the lower reading. For the same reasons, the tensile strength was lower (0.008 x 10^6 kPa, or 1210 psi). Although it is not clear whether the faunal content or the hardground was the more significant in accounting for the greater weakness of the rock, the two features are directly related (faunal fragments lie directly upon hardground surfaces), and some importance must be attached to the presence of such surfaces. The upper Burr Member in this area contains locally twenty hardgrounds within a stratigraphic interval of about 40 ft (12 m), thus providing as many discontinuity surfaces to act as planes of relative weakness. Consequently, the lower compressive and tensile strengths recorded from the upper Burr Member are probably the more representative. Notwithstanding, the Dawson Bay, above the poorly cohesive Second Red Bed, is a formation of high integral strength, containing no surface of discontinuity which would act as a serious plane of décollement.

Dawson Bay Member	Compressive Strength kPa x 10^6		Tensile Strength kPa x 10^6		Young's Modulus kPa x 10^6		Poisson's Ratio
Upr. Neely	0.204	(29,600 psi)	0.014	(2000 psi)	32.4	(4.7)*	0.14
Lwr. Neely	0.172	(24,900 psi)	0.014	(2080 psi)	51.7	(7.5)*	0.24
Upr. Burr	0.243	(35,300 psi)	0.017	(2490 psi)	54.5	(7.9)*	0.26
Lwr. Burr	0.171	(24,800 psi)	0.016	(2330 psi)	37.2	(5.4)*	0.20
Average of all results	0.207	(30,000 psi)	0.016	(2300 psi)	46.0	(6.7)*	0.22

* values in parenthesis are in psi x 10^6

TABLE 5: Summary of rock mechanics tests made upon cored sections from the Dawson Bay Formation

SASK LEGISLATIVE LIBRARY
NOV 23
REGINA

Sample No.	Well†	Dawson Bay Member	Depth Below KB m	(ft)	Description	Compressive Strength kPa x 10^6	(psi)	Tensile Strength kPa x 10^6	(psi)	Young's Modulus* kPa x 10^6	(psi)	Poisson's** Ratio
1	A	Neely	975	(3198)	ANHYDRITE; whitish with grey/blue mottles. Dolomite, cryptocrystalline pale buff, intimately mixed, and as diffuse laminae. Massive; dense.	0.190	(27,500)	0.013	(1820)	37.2	(5.40)***	0.125
2	B	Neely	949	(3114)	ANHYDRITE; bluish. Interlaminated with greenish mudstone. Massive; dense.	0.214	(31,000)	0.017	(2400)	22.8	(3.31)***	0.107***
3	C	Neely	991	(3250)	ANHYDRITE; very similar to sample no. 1 except dolomite laminae are very poorly defined. Massive; dense.	0.209	(30,300,	0.012	(1720)	37.0	(5.37)***	0.200***
4	A	Neely	981	(3217)	LIMESTONE; drab medium brown. Microcrystalline to finely sucrosic. Diffuse wispy bituminous laminae. Crinoid ossicles. Fair porosity and permeability.	0.168	(24,400)	0.015	(2170)	53.0	(7.69)	0.208
5	B	Neely	951	(3121)	LIMESTONE; as above, except corals and small bluish anhydrite nodules present.	0.140	(20,300)	0.013	(1820)	52.4	(7.60)	0.234
6	C	Neely	992	(3256)	LIMESTONE; same as sample no. 4.	0.206	(29,900)	0.016	(2370)	50.3	(7.30)	0.267
7	A	Burr	988	(3242)	LIMESTONE; pale greyish-brown. Cryptocrystalline. Few crinoid ossicles. Low porosity and permeability.	0.314	(45,600)	0.018	(2670)	67.0	(9.72)	0.313
8	A	Burr	996	(3267)	LIMESTONE; same as sample no. 7.	0.288	(41,800)	0.018	(2660)	70.3	(10.20)	0.273
9	B	Burr	964	(3164)	LIMESTONE; very similar to samples no. 8 and no. 7, except some pale anhydrite present.	0.245	(35,500)	0.016	(2360)	50.1	(7.27)	0.301
10	B	Burr	966	(3170)	LIMESTONE; medium brown. Crypto- to micro-crystalline. Wispy bituminous laminae. Few crinoid ossicles. Low porosity and permeability.	0.249	(36,100)	0.018	(2580)	57.9	(8.40)	0.248
11	C	Burr	1003	(3290)	LIMESTONE; pale grey, mottled. Crypto- to micro-crystalline. Crinoid ossicles. Low porosity and permeability.	0.210	(30,500)	0.018	(2650)	33.4	(4.85)	0.230
12	C	Burr	1006	(3300)	LIMESTONE; pale greyish-brown. Cryptocrystalline. Abundant faunal fragments, and hardground present. Low porosity and permeability.	0.155	(22,500)	0.008	(1210)	47.0	(6.82)	0.207
13	A	Burr	998	(3274)	DOLOMITE; argillaceous. Dark greenish-grey. Bioturbated. Low porosity and permeability.	0.161	(23,400)	0.016	(2350)	24.6	(3.57)	0.123***
14	B	Burr	974	(3195)	LIMESTONE; dolomitic and argillaceous. Medium greenish-grey. Bioturbated. Low porosity and permeability.	0.197	(28,500)	0.018	(2540)	44.0	(6.38)	0.221
15	C	Burr	1012	(3320)	LIMESTONE; dolomitic and argillaceous. Same as sample no. 14.	0.155	(22,500)	0.013	(1890)	42.1	(6.10)	0.269

† Well A = Duval Potash Saskatoon 15 2 37 6 (Lsd. 15-2-37-6W3)
Well B = Duval Potash Saskatoon 1 11 37 7 (Lsd. 1-11-37-7W3)
Well C = Duval Potash Saskatoon 8 22 36 7 (Lsd. 8-22-36-7W3)

* = Load v. axial strain: graphs are in most cases linear, otherwise tangent taken at origin; therefore minimum modulus is quoted.
** Ratio of lateral to axial strain: tangent at origin unless indicated otherwise.
*** Tangent at 0.0207 kPa (3000 psi) axial stress.

TABLE 4: Rock Mechanics Data

SUMMARY AND CONCLUSIONS

Study of cores, logs and all other information available from over 300 wells has resulted in the following main observations concerning the Dawson Bay Formation in the Saskatoon potash mining district:

1. Paleontological evidence indicates that the formation belongs to the Givetian Stage of the Middle Devonian.

2. The formation is the lowermost of the several major cycles of sedimentation which make up the Manitoba Group.

3. The six members into which the formation was previously divided can conveniently be reduced to four: Second Red Bed, Burr (new name), Neely (new name), and Hubbard Evaporite.

4. The Second Red Bed is about 14 ft (4 m) thick and shows little regional variation in thickness or lithology. It is poorly consolidated dolomitic mudstone which is usually red at the base and grades upward through brown to grey. The uppermost few centimetres are typically finely laminated and better lithified.

5. The Burr Member maintains a regonal thickness of 65 ft (20 m) and is composed of microcrystalline to cryptocrystalline carbonates which lie with minor angular unconformity upon the Second Red Bed. The lower strata are bioturbated and unfossiliferous. Most of the sequence is fossiliferous limestonc characterized by numerous planes of discontinuity identified as hardgrounds.

6. The Neely Member maintains a thickness of 50-60 ft (15-18 m) and is composed of microcrystalline to sucrosic carbonates capped with anhydrite. The sequence commences with an argillaceous carbonate above a well-defined hardground, and is succeeded by bituminous carbonates with dominant stromatoporoids and stringocephalid brachiopods. Algal mats or stromatolites occur near the top, beneath intermingled dolomite and anhydrite. Porosity is commonly plugged by halite.

7. The Hubbard Evaporite is a halite bed restricted to the eastern half of the study area, where it reaches a maximum thickness of 46 ft (14 m) in the southeast. There is frequently a transitional contact up to the Souris River Formation.

8. Limestone is the dominant lithology of the Dawson Bay Formation, but dolomite becomes more prevalent toward the northwest.

9. The depositional history is interpreted as commencing with a marine transgression from the east or north under hot arid conditions. Deepening of seas during deposition of the Burr Member resulted in conditions becoming favourable for marine fauna. Numerous breaks in deposition are witnessed by hardgrounds which may reflect periodic changes in the movement of bottom currents. Faunal evidence suggests that the Neely Member derived its sediments from the west. Steadily shallowing seas gave rise to patch reefs, and eventually sabkha conditions prior to desiccation and precipitation of the Hubbard halite.

10. Fractures are predominantly near vertical and commonly filled with halite. Vertical displacement of strata is very small except above major salt-solutioning features, where large and small blocks of Dawson Bay carbonates have foundered into the subterranean cavities. Structure contour maps help outline salt-solution features, and cored sections showing the resultant intraformational breccias confirm their presence. Locally, blocks of Dawson Bay carbonate have fallen into caverns and were followed by salt creep, due to lithostatic pressure, giving rise to a reversed stratigraphic sequence.

11. Examination of variations in salt-back thickness above the Patience Lake Potash helps to delineate areas of partial salt-solutioning, areas of non-deposition of some potash beds, and areas of local solutioning of the potash.

12. Formation fluids are all salt-water. Drill-stem-test data show that large areas of the Dawson Bay Formation are "dry": this is because halite has plugged the pores. Channels of water-bearing Dawson Bay strata do occur, and tend to be related to seismic lows.

13. A map of the potentiometric surface indicates that pressures decrease toward the northeast. A small potentiometric cell may occur to the southwest of Saskatoon.

14. Rock mechanics data (uniaxial tests) show that the Dawson Bay carbonates are of unusually high strength, and are of the moderately high elasticity to be expected.

ACKNOWLEDGEMENTS

The co-operation of the potash mine operators is greatly appreciated, and I especially thank G. McLaughlin (PCS), G. McVittie (Cominco), and K. Cahoun (Central Canada) for permission to publish hitherto confidential data.

I acknowledge with appreciation the help and information provided by the following past and present employees of the Department: Drs. A. C. Kendall and W. Potts for many useful discussions; B. Drever, L. Smith and D. Bean for assistance in data compilation; J. Harbinson, W. Schoffer for typing the manuscript; and Drs. J. E. Christopher and D. F. Paterson for editorial comments. Credit for the drafting goes to P. Weir, G. Chow and E. Sloat, under the supervision of J. Toews and P. Kydd. Final thanks go to the many individuals who have contributed their ideas, opinions and assistance.

REFERENCES

Anderson, S. B., and Hunt, J. B., 1964. Devonian Salt Solution in North-Central North Dakota. In: Third International Williston Basin Symposium, Regina, Sask., Billings Geol. Soc., N. Dak. Geol. Soc., Sask. Geol. Soc., Billings, p. 93-104.

Andrichuk, J. M., 1951. Regional Stratigraphic Analysis of the Devonian System in Wyoming, Montana, Southern Saskatchewan and Alberta. Amer. Assoc. Petrol. Geol., Bull., *35*, p. 2368-2408. Reprinted with revisions, Western Canada Sedimentary Basin, Amer. Assoc. Petrol. Geol., p. 68-108.

Baillie, A. D., 1951. Devonian Geology of Lake Manitoba — Lake Winnipegosis Area. Man. Dept. Mines and Nat. Res., Mines Branch, Publ. 49-2, pp. 74.

Baillie, A. D., 1953. Devonian System of the Williston Basin Area. Man. Dept. Mines and Nat. Res., Mines Branch, Publ. 52-5.

Bannatyne, B. B., 1975. High-Calcium Limestone Deposits of Manitoba, Man. Det. of Mines, Res. and Env. Management, Publ. 75-1, pp. 103.

Bassett, H. G., and Stout, J. G., 1967. Devonian of Western Canada. In: "International Symposium on the Devonian System", Ed. D. H. Oswald, Alberta Soc. Petrol. Geol., Vol. 1, p. 717-752.

Bishop, R. A. 1953. Types of Local Sedimentary Structure in Saskatchewan (abstract), Geol. Soc. America Bull., *64*, p. 1541.

Bishop, R. A., 1954. Saskatchewan Exploratory Progress and Problems. In: "Western Canada Sedimentary Basin Symposium, Rutherford Memorial Volume". Amer. Assoc. Petrol. Geol., p. 474-485.

Bishop, R. A., 1974. Hummingbird Structure, Saskatchewan, Single vs. Multiple Stage Salt Solution Collapse. In: "Fuels: A Geological Appraisal", Ed. G. R. Parslow, Sask. Geol. Soc. Sp. Publ. No. 2, p. 179-197.

Christiansen, E. A., 1967. Collapse Structures Near Saskatoon, Saskatchewan, Canada. Can. Jour. of Earth Sciences, *4*, p. 757-767.

Christopher, J. E., 1961. Transitional Devonian — Mississippian Formations of Southern Saskatchewan. Sask. Dept. Min. Res., Report 66, pp. 103.

Christopher, J. E., 1974. The Upper Jurassic Vanguard and Lower Cretaceous Mannville Groups of Southwestern Saskatchewan. Sask. Dept. Min. Res., Report 151, pp. 349.

Christopher, J. E., 1980. The Lower Cretaceous Mannville Group of Saskatchewan — A Tectonic Over-View. In: "Lloydminster and Beyond: Geology of Mannville Hydrocarbon Reservoirs" Eds. L. S. Beck, J. E. Christopher, D. M. Kent. Sask. Geol. Soc. Special Publ. No. 5, p. 3-32.

Crickmay, C. H., 1954. Paleontological Correlation of Elk Point and Equivalents. *In* "Western Canada Sedimentary Basin Symposium", Ed. L. M. Clark, Amer. Assoc. Petrol. Geol., Ralph Leslie Rutherford Memorial Volume, p. 143-158.

Crickmay, C. H., 1960. Studies of the Western Canada Stringocephalinae. Jour. Paleontology, *34*, p. 874-890.

Crickmay, C. H., 1961. The Misinterpreted Middle Devonian of Saskatchewan. Alberta Soc. Petrol. Geol. Jour., *9:1*, p. 10-14.

Cumming, A. D., Fuller, J. G. C. M., Porter, J. W., 1959. Separation of Strata — Palaeozoic Limestones of the Williston Basin. Am. J. Sci., *257*, p. 722-733.

De Mille, G., Shouldice, J. R., and Nelson, H. W., 1964. Collapse Structures Related to Evaporites of the Prairie Formation, Saskatchewan. Geol. Soc. Amer. Bull., *75*, p. 307-316.

Dunn, C. E., 1975a. The Middle Devonian Dawson Bay Formation in the Saskatoon Area. In: "Summary of Investigations 1975 by the Saskatchewan Geological Survey", Eds. J. E. Christopher and R. Macdonald. Sask. Dept. Min. Res., p. 71-72.

Dunn, C. E., 1975b. The Upper Devonian Duperow Formation in Southeastern Saskatchewan. Sask. Dept. Min. Res., Report 179, pp. 151.

Dunn, C. E., 1976. Saskatchewan Potash in 1975 — An Update on our Knowledge. In: Eleventh Industrial Minerals Forum. Montana Bureau of Mines and Geology, Sp. Publ. No. 74, p. 51-60.

Dunn, C. E., and Kendall, A. C., 1978. *Gasterocoma* from the Givetian of Manitoba and Saskatchewan. Bull. Can. Petrol. Geol., *26*: 1, p. 159-161.

Edie, R. W., 1958. Middle Devonian Elk Point Group and Dawson Bay Formation, Central Saskatchewan (abstract). North Dakota Geol. Soc. and Sask. Geol. Soc., 2nd International Williston Basin Symposium. Conrad Publ. Co., Bismarck, N. Dakota.

Edie, R. W., 1959. Middle Devonian Sedimentation and Oil Possibilities, Central Saskatchewan, Canada. Bull. Amer. Assoc. Petrol. Geol., *43*, p. 1026-1057.

Fuzesy, L. M., 1980. Geology of the Deadwood (Cambrian), Meadow Lake and Winnipegosis (Devonian) Formations in West-Central Saskatchewan. Sask. Dept. Min. Res. Report 210, pp. 64.

Gendzwill, D. J., 1978. Winnipegosis Mounds and Prairie Evaporite Formation of Saskatchewan — Seismic Study. Bull. Amer. Assoc. Petrol. Geol., *62* (1), p. 73-86.

Grayston, L. D., Sherwin, D. F., and Allan, J. R., 1964. Middle Devonian. In: Geological History of Western Canada (Eds. R. G. McCrossan and R. P. Glaister). Alberta Soc. Petrol. Geol., Calgary, pp. 232.

Holter, M. E., 1969. The Middle Devonian Prairie Evaporite of Saskatchewan. Sask. Dept. Min. Res., Report 123, pp. 134.

Kendall, A. C., 1976. The Ordovician Carbonate Succession (Bighorn Group) of Southeastern Saskatchewan. Sask. Dept. Min. Res., Report 180, pp. 185.

Kent, D. M., 1968. The Geology of the Upper Devonian Saskatchewan Group and Equivalent Rocks in Western Saskatchewan and Adjacent Areas. Sask. Dept. Min. Res., Report 99, pp. 221.

Kent, D. M., and Paterson, D. F., 1967. Geological Road Log of the Lakes Winnipegosis and Manitoba Areas, Manitoba. Sask. Geol. Soc. 1967 Field Trip, pp. 20.

Kindle, E. M., 1914. The Silurian and Devonian Section of Western Manitoba. Geol. Surv. Can., Summ. Report. 1912, p. 247-261.

Lahey, B. A. L., 1964. Relationships Between the Middle Devonian Prairie Evaporite Formation and the "Salt-Free" Area of South Central Saskatchewan. M. A. Thesis, University of Sask., pp. 61.

Lane, D. M., 1959. Dawson Bay Formation in the Quill Lakes — Qu'Appelle Area Saskatchewan. Sask. Dept. Min. Res., Report 38, pp. 51.

Longman, M. W., and Mench, P. A., 1978. Diagenesis of Cretaceous Limestones in the Edwards Aquifer System of South-Central Texas: A Scanning Electron Microscope Study. Sedimentary Geology, *21*, p. 241-276.

MacLennan, D. B. and Kamen-Kaye, M., 1954. Subsurface Exploration Geology and Devonian Prospects of the Meadow Lake-Prince Albert-Yorkton Area, Saskatchewan. Sask. Dept. Min. Res. Report 15, pp. 30.

Matthieson, E., (in prep.). Givetian and Frasnian Microfauna from Saskatchewan and Manitoba. M.Sc. Thesis, University of Saskatchewan.

McCabe, H. R., 1967. Tectonic Framework of Palaeozoic Formations in Manitoba. C.I.M., *60*, p. 180-189.

McCammon, H., 1960. Fauna of the Manitoba Group in Manitoba. Man. Dept. of Mines and Natural Res., Publication 59-6, pp. 109.

McGehee, J. R., 1949. Pre-Waterways Paleozoic Stratigraphy of Alberta Plains. Bull. Amer. Assoc. Petrol. Geol., *33*:4, p. 603-613.

Nelson, S. J., 1975. The Face of Time. Alberta Soc. Petrol. Geol., pp. 133.

Nichols, R. A. H., 1970. The Petrology and Economic Geology of the Upper Devonian Birdbear Formation in Southeastern Saskatchewan. Sask. Dept. Min. Res. Rept. 125, pp. 93.

Norris, A. W. and Uyeno, T. T., 1971. Stratigraphy and Conodont Faunas of Devonian Outcrop Belts, Manitoba. *In*: "Geoscience Studies in Manitoba", Ed. A. C. Turnock. Geol. Assoc. Can., Spec. Paper No. 9, p. 209-223.

Paterson, D. F., 1973. Computer Plotted Isopach and Structure Maps of the Devonian Formations in Saskatchewan. Sask. Dept. Min. Res. Report 164.

Paterson, D. F., 1975. Computer Plotted Isopach and Structure Maps of the Lower Palaeozoic Formations in Saskatchewan. Sask. Dept. Min. Res. Report 165.

Powley, D. E., 1951. Devonian Stratigraphy of Central Saskatchewan. M.Sc. Thesis, University of Saskatchewan, pp. 98.

Price, L. L., 1955. Columnar Sections of Wells Across Southern Saskatchewan. Geol. Surv. Canada, Paper 54-16, pp. 7.

Prokopovich, N., 1955. The Nature of Corrosion Zones in the Middle Ordovician of Minnesota. J. Sed. Pet., *25*:3, p. 207-215.

Reed, P. E. C., 1970. Discontinuity Surfaces in Beaverhill Lake Group (Devonian) Limestones, Alberta. (Abstract) Bull. Amer. Assoc. Petrol. Geol., *54*:1, p. 866.

Savage, T. E. and Van Tuyl, F. M., 1919. Geology and Stratigraphy of the Area of Paleozoic Rocks in the Vicinity of Hudson and James Bays. Bull. Geol. Soc. Amer., *30*, p. 339-377.

Siegel, F. R., 1967. Properties and Uses of the Carbonates. *In*: "Developments in Sedimentology 9B: Carbonate Rocks, Physical and Chemical Aspects", Eds. G. V. Chilingar, H. J. Bissell, R. W. Fairbridge. Elsevier, New York, pp. 413.

Stanton, M. W., 1953. Ordovician, Silurian and Devonian Stratigraphy of Western Saskatchewan. Billings Geol. Soc. Guidebook, 4th Ann. Field Conf., p. 59-63.

Tyrell, J. B., 1892. Report on North-Western Manitoba with Portions of the Adjacent Districts of Assiniboia and Saskatchewan. Geol. Surv. Canada, Pt. E., Ann. Report., 5, 1889-90-91, pp. 240.

Walker, C. T., 1956. The Middle Devonian Rocks of Western Saskatchewan. *In* : First International Williston Basin Symposium, p. 131-139, *Conrad*, Bismarck, N.D.

Walker, C. T., 1957. Correlations of Middle Devonian Rocks in Western Saskatchewan. Sask. Dept. Min. Res., Report 25, pp. 59.

Warren, P. S. and Stelck C. R., 1956. Devonian Faunas of Western Canada — Part 1, Reference Fossils of Canada. Geol. Assoc. Canada, Spec. Publ. No. 1, pp. 15.

Whiteaves, J. F., 1891. Descriptions of Some Previously Unrecorded Species of Fossils from the Devonian Rocks of Manitoba. Trans. Roy. Soc. Can., *8* :1V, p. 93-110.

Whiteaves, J. F., 1892. The Fossils of the Devonian Rocks of the Islands, Shores or Immediate Vicinity of Lakes Manitoba and Winnipegosis. Geol. Surv. Can., Contr. Can. Pal., *1* :4, 6 p. 255-359.

Wickenden, R. T. D., 1934. Palaeozoic and Jurassic Formations in Well Sections in Manitoba. Geol. Surv. Canada, Summ. Rept. 1933, pt. B.

Wilson, J. L., 1967. Carbonate-Evaporite Cycles in Lower Duperow Formation of Williston Basin. Bull. Can. Petrol. Geol., *15* :3, p. 230-312.

APPENDIX I

WELL DATA

1. Formation and member limits determined from cores and geophysical well logs.
2. K.B. = Kelly bushing elevation above sea-level.
3. T.D. = total depth of well below K.B.
4. "E" = estimated depth.
5. A dash indicates that the well was terminated before reaching a particular member.

Location	Well Name	K.B.		T.D.		Dawson Bay Top		Dawson Bay Thickness	
		ft	m	ft	m	ft	m	ft	m
5-31-29-20W2	KR Nokomis 5 31 29 20	1753	(534)	3806	(1160)	3295	(1004)	159	(48.5)
9-2-30-20W2	Charter Bueno Nokomis No. 9 2	1761	(537)	4091	(1247)	3238	(987)	162	(49.4)
14-3-30-20W2	Security Banff Nokomis 14 3 30 20	1737	(529)	4663	(1238)	3225	(983)	130	(39.6)
4-4-30-20W2	KR Nokomis 4 4 30 20	1734	(529)	3905	(1190)	3279	(999)	174	(53.0)
8-7-30-20W2	KR et al Nokomis 8 7 30 20	1751	(534)	3640	(1109)	3267	(996)	152	(46.3)
6-13-30-20W2	Socony Sohio Copeland No. 1	1743	(531)	4028	(1289)	3181	(970)	159	(48.5)
15-17-30-20W2	KR Nokomis 15 17 30 20	1743	(531)	3751	(1143)	3253	(992)	155	(47.2)
13-18-30-20W2	KR Nokomis 13 18 30 20	1739	(530)	4033	(1229)	3235	(986)	155	(47.2)
12-22-31-20W2	US Borax Jansen 12 22 31 20	1750	(533)	3800	(1158)	3232	(985)	127	(38.7)
1-13-32-20W2	USP Jansen No. 1	1736	(529)	3363	(1025)	2956	(901)	164	(50.0)
8-20-33-20W2	Kerr McGee Esk 8 20 33 20	1805	(550)	3248	(990)	2940	(896)	166	(50.6)
8-22-33-20W2	Kerr-McGee Esk 8 22 33 20	1784	(544)	3250	(991)	2914	(888)	166	(50.6)
9-26-33-20W2	Kerr-McGee Jansen 9 26 33 20	1783	(543)	3208	(978)	2881	(878)	174	(53.0)
1-2-34-20W2	Kerr-McGee Jansen 1 2 34 20	1791	(546)	3209	(978)	2876	(877)	157	(47.9)
1-4-34-20W2	Kerr-McGee Jansen 1 4 34 20	1795	(547)	3210	(978)	2886	(880)	150	(45.7)
16-12-34-20W2	Kerr-McGee Jansen Lake 16 12 34 20	1785	(544)	3140	(957)	2812	(857)	170	(51.8)
21-4-14-34-20W2	Kerr-McGee Jansen Lake 4 14 34 20	1795	(547)	3152	(961)	2860	(872)	136	(41.5)
11-4-16-34-20W2	Kerr-McGee Jansen Lake 4 16 34 20	1784	(544)	3220	(981)	2914	(888)	136	(41.5)
1-28-34-20W2	Kerr-McGee Jansen Lake 1 28 34 20	1791	(546)	3110	(948)	2798	(853)	164	(50.0)
11-24-38-20W2	Honolulu Annaheim 11 24	1934	(589)	3530	(1076)	2895	(882)	131	(39.9)
15-14-40-20W2	Schriner 15	1828	(557)	4046	(1233)	2641	(805)	117	(35.7)
13-24-29-21W2	KR Nokomis 13 24 29 21	1759	(536)	4198	(1280)	3395	(1035)	142	(43.3)
10-29-29-21W2	Socony Sohio Nokomis No. 29 10	1757	(536)	5150	(1570)	3426	(1044)	184	(56.1)
16-2-30-21W2	KR Nokomis 16 2 30 21	1726	(526)	4121	(1256)	3273	(998)	159	(48.5)
14-14-30-21W2	KR Nokomis 14 14 30 21	1761	(537)	3792	(1156)	3313	(1010)	152	(46.3)
6-29-30-21W2	General Petroleums Kutawagon 6-29	1768	(539)	3674	(1120)	3293	(1004)	137	(41.8)
5-34-30-21W2	Pheas Arco Lockwood 5 34 30 21	1771	(540)	4917	(1499)	3229	(984)	125	(38.1)
16-12-31-21W2	Shell Quill Lake 16 12 31 21	1754	(535)	4099	(1249)	3162	(964)	129	(39.3)
8-32-31-21W2	Pheas Shell Drake 8 32 31 21	1752	(534)	3994	(1217)	3130	(954)	172	(52.4)
13-4-33-21W2	Potash of America Lanigan 13 4 33 21	1767	(539)	3269	(996)	3026	(922)	159	(48.5)
14-22-33-21W2	Kerr-McGee Sinnett 14 22 33 21	1774	(541)	3260	(994)	2958	(902)	148	(45.1)
13-29-33-21W2	Kerr-McGee Lanigan 13 29 33 21	1766	(538)	3290	(1003)	2949	(899)	138	(42.1)
12-34-33-21W2	Kerr-McGee Sinnett 12 34 33 21	1761	(537)	3195	(974)	2895	(882)	155	(47.2)
8-36-33-21W2	Kerr-McGee Esk 8 36 33 21	1778	(542)	3252	(991)	2927	(892)	157	(47.9)
5-10-34-21W2	Kerr-McGee Sinnett 5 10 34 21	1783	(543)	3224	(983)	2895	(882)	165	(50.3)
16-12-34-21W2	Kerr McGee Jansen Lake 16 12 34 21	1779	(542)	3141	(957)	2835	(864)	161	(49.1)
4-32-34-21W2	Alwinsal Loyola 4 32	1808	(551)	3391	(1034)	2869	(874)	125	(38.1)
13-4-35-21W2	Alwinsal Loyola 13 4	1829	(557)	3402	(1037)	2886	(880)	137	(41.8)
13-6-35-21W2	Alwinsal Attica 13 6	1850	(564)	3398	(1036)	2945	(898)	135	(41.1)
7-11-35-21W2	Winsal Sinnett No. 7 11	1816	(554)	3193	(973)	2868	(874)	144	(43.9)
13-16-35-21W2	Alwinsal Caseyville 13 16	1849	(564)	3207	(977)	2863	(873)	146	(44.5)
6-2-37-21W2	Honolulu Gregor 6 2	1939	(591)	3736	(1139)	2828	(862)	130	(39.6)
16-10-30-22W2	S W P Nokomis 16 10 30 22	1743	(531)	4120	(1256)	3308	(1008)	132	(40.2)
16-11-32-22W2	Kerr-McGee Drake 16 11 32 22	1763	(537)	3427	(1045)	3120	(951)	135	(41.1)
4-29-32-22W2	White Rose et al Drake 4 29 32 22	1746	(532)	4050	(1234)	3110	(948)	148	(45.1)
13-18-33-22W2	Alwinsal Cree 13 18	1761	(537)	3443	(1049)	3173	(967)	135	(41.1)
1-29-33-22W2	Duval Potash Co Guernsey 1 29 33 22	1779	(542)	3473	(1059)	3128	(953)	124	(37.8)
4-14-35-22W2	US Borax Chem Corp Burr 4 14 35 22	1846	(563)	3262	(994)	2939	(896)	127	(38.7)
5-21-36-22W2	Pheas Arco Bay 5 21 36 22	1830	(558)	3653	(1113)	2873	(876)	125	(38.1)
2-14-38-22W2	Sohio Allenbee Moseley 2 14 38 22	1875	(572)	3620	(1103)	2748	(838)	125	(38.1)
16-29-38-22W2	Marysburg No. 1	1825	(556)	4155	(1266)	2654	(809)	125	(38.1)
14-6-40-22W2	Pheas Cankee Humboldt 14A 6 40 22	1858	(566)	3994	(1217)	2835	(864)	117	(35.7)
9-29-29-23W2	Socony-Sohio Axe Lake No. 1	1643	(501)	3543	(1080)	3328	(1014)	134	(40.8)
1-12-30-23W2	Scurry Boulder Lake 1 12 30 23	1690	(515)	3624	(1105)	3315	(1010)	142	(43.3)
5-15-30-23W2	S W P Boulder Lake 5 15 30 23	1669	(509)	3847	(1173)	3316	(1011)	139	(42.4)
13-16-30-23W2	S W P Boulder Lake 13 16 30 23	1681	(512)	3773	(1150)	3282	(1000)	147	(44.8)
1-18-30-23W2	S W P Boulder Lake 1 18 30 23	1662	(507)	3870	(1180)	3322	(1013)	150	(45.7)
01-16-18-30-23W2	S.W.P. Boulder Lake 16 18 30 23	1657	(505)	3740	(1140)	3252	(991)	142	(43.3)
02-16-18-30-23W2	S W P 3 Boulder Lake 16 18 30 23	1657	(505)	3534	(1077)	3252	(991)	142	(43.3)
12-20-30-23W2	S W P Boulder Lake 12 20 30 23	1658	(505)	3754	(1144)	3251	(991)	151	(46.0)
1-24-30-23W2	Scurry Boulder Lake 1 24 30 23	1686	(514)	3628	(1106)	3299	(1006)	153	(46.6)

Hubbard Mbr. Thickness		Neely Mbr. Top		Burr Mbr. Top		Second Red Bed Mbr. Top		Prairie Evaporite Top		Patience Lake Mbr. Top		Dawson Bay Cored Intervals	
ft	m	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m
25	(7.6)	3320	(1012)	3374	(1028)	3438	(1048)	3454	(1053)	3475	(1060)	3305-3453	(1007-1053)
18	(5.5)	3256	(992)	3304	(1007)	3373	(1028)	3388	(1033)	3400	(1036)		
		3225	(983)	3274	(998)	3340	(1018)	3355	(1023)	3380	(1030)		
38	(11.6)	3317	(1011)	3372	(1028)	3437	(1048)	3453	(1052)	3470	(1058)	3416-3453	(1041-1052)
16	(4.1)	3283	(1001)	3333	(1016)	3404	(1038)	3419	(1042)	3437	(1047)	3279-3419	(999-1042)
22	(6.7)	3203	(976)	3260	(994)	3325	(1013)	3340	(1018)	3359	(1024)		
15	(4.6)	3268	(996)	3328	(1014)	3390	(1034)	3408	(1039)	3423	(1043)	3255-3408	(992-1039)
20	(6.1)	3255	(992)	3313	(1010)	3375	(1029)	3390	(1033)	3415	(1041)	3372-3390	(1028-1033)
		3232	(985)	3276	(998)	3342	(1019)	3359	(1024)	3382	(1031)	3274-3314	(998-1010)
27	(8.2)	2983	(909)	3034	(925)	3104	(946)	3120	(951)	3141	(957)	3067-3120	(935-951)
28	(8.5)	2968	(905)	3026	(922)	3092	(942)	3106	(947)	3140	(957)	2965-3106	(904-947)
34	(10.4)	2948	(899)	2995	(913)	3065	(934)	3080	(939)	3109	(948)	3010-3080	(917-939)
46	(14.0)	2927	(892)	2976	(907)	3040	(927)	3055	(931)	3080	(939)	2998-3055	(914-931)
28	(8.5)	2904	(885)	2954	(900)	3020	(920)	3033	(924)	3073	(937)	2960-3033	(902-924)
26	(8.0)	2912	(888)	2958	(902)	3022	(921)	3036	(925)	3076	(938)	2970-3036	(905-925)
46	(14.0)	2858	(871)	2905	(885)	2968	(905)	2982	(909)	3006	(916)	2900-2982	(884-909)
17	(5.2)	2877	(877)	2919	(890)	2981	(907)	2996	(913)	3030	(924)	2968-2996	(905-913)
17	(5.2)	2931	(983)	2972	(906)	3035	(925)	3050	(930)	3070	(938)	2980-3050	(908-930)
42	(12.8)	2840	(866)	2882	(878)	2946	(898)	2962	(903)	2978	(908)	2900-2962	(884-903)
		2895	(882)	2940	(896)	3007	(917)	3026	(922)	Absent			
		2641	(805)	2683	(818)	2735	(833)	2758	(841)	Absent			
17	(5.2)	3412	(1040)	3452	(1052)	3523	(1074)	3537	(1078)	3550	(1082)	3485-3537	(1062-1078)
46	(14.0)	3472	(1058)	3525	(1074)	3595	(1096)	3610	(1100)	Absent			
23	(7.0)	3296	(1005)	3346	(1020)	3418	(1042)	3432	(1046)	3453	(1052)	3420-3432	(1042-1046)
26	(7.9)	3339	(1018)	3388	(1033)	3452	(1052)	3465	(1056)	Absent		3315-3465	(1010-1056)
10	(3.0)	3303	(1007)	3350	(1021)	3415	(1041)	3430	(1045)	3450	(1052)	3424-3430	(1044-1045)
3	(0.9)	3232	(985)	3277	(999)	3341	(1018)	3354	(1022)	3382	(1031)		
		3162	(964)	3213	(979)	3275	(998)	3291	(1003)	3304	(1007)		
40	(12.2)	3170	(966)	3225	(983)	3289	(1002)	3302	(1006)	3320	(1012)		
20	(6.1)	3046	(928)	3115	(949)	3170	(966)	3185	(971)E	3207	(977)	3170-3185	(966-971)
18	(5.5)	2976	(907)	3027	(923)	3091	(942)	3106	(947)	3135	(956)	3020-3106	(921-947)
11	(3.4)	2960	(902)	3010	(917)	3072	(936)	3087	(941)	3111	(948)	3029-3087	(923-941)
24	(7.3)	2919	(890)	2965	(904)	3034	(925)	3050	(930)	3068	(935)	2895-3050	(882-930)
20	(6.1)	2947	(898)	2996	(913)	3068	(935)	3084	(940)	3102	(945)	3010-3084	(917-940)
40	(12.2)	2935	(895)	2984	(910)	3045	(928)	3060	(933)	3088	(941)	2981-3060	(909-933)
25	(7.6)	2860	(872)	2910	(887)	2980	(908)	2996	(913)	3010	(917)	2900-2996	(884-913)
		2869	(874)	2917	(889)	2980	(908)	2994	(913)	3002	(915)	2869-2994	(874-913)
6	(1.8)	2892	(881)	2943	(897)	3009	(917)	3023	(921)	3043	(928)	3004-3023	(916-921)
3	(0.9)	2948	(899)	3004	(917)	3065	(934)	3080	(939)	3100	(945)	3047-3080	(929-939)
20	(6.1)	2888	(880)	2936	(895)	2997	(913)	3012	(918)	3037	(926)		
17	(5.2)	2880	(878)	2932	(894)	2994	(913)	3009	(917)	3029	(924)	2870-3009	(875-917)
		2828	(862)	2883	(878)	2943	(897)	2958	(902)	2964	(903)		
		3308	(1008)	3355	(1023)	3424	(1044)	3440	(1049)	3456	(1053)	3438-3440	(1048-1049)
7	(2.1)	3127	(953)	3178	(969)	3240	(988)	3255	(992)	3272	(997)	3190-3255	(972-992)
15	(4.6)	3125	(953)	3178	(969)	3243	(988)	3258	(993)	3288	(1002)		
8	(2.4)	3181	(970)	3226	(983)	3293	(1004)	3308	(1008)	3324	(1013)	3293-3308	(1004-1008)
		3128	(953)	3185	(971)	3239	(987)	3252	(991)	3301	(1006)	3159-3252	(962-991)
		2939	(896)	2990	(911)	3049	(929)	3066	(934)	3100	(945)	3045-3066	(928-935)
		2873	(876)	2916	(889)	2983	(909)	2998	(914)	3022	(921)		
		2748	(838)	2792	(851)	2866	(874)	2883	(879)	Absent			
		2654	(808)	2700	(823)	2768	(845)	2779	(847)	Absent		2665-2696	(812-822)
												2772-2779	(845-847)
		2835	(864)	2873	(876)	2930	(893)	2952	(900)	Absent			
		3328	(1014)	3382	(1031)	3450	(1052)	3462	(1055)	3470	(1058)		
3	(0.9)	3318	(1011)	3372	(1028)	3442	(1049)	3457	(1054)	3469	(1057)	3450-3457	(1052-1054)
8	(2.4)	3324	(1013)	3376	(1029)	3440	(1049)	3455	(1053)	3490	(1064)	3317-3455	(1011-1053)
9	(2.7)	3291	(1003)	3343	(1019)	3413	(1040)	3429	(1045)	3447	(1051)	3380-3429	(1030-1045)
14	(4.3)	3336	(1017)	3389	(1033)	3460	(1055)	3472	(1058)	3492	(1064)		
18	(5.5)	3266	(995)	3308	(1008)	3383	(1031)	3394	(1034)	3405	(1038)	3380-3394	(1030-1034)
14	(4.3)	3270	(997)	3308	(1008)	3383	(1031)	3394	(1034)	3408	(1039)	3366-3394	(1026-1034)
24	(7.3)	3275	(998)	3322	(1012)	3390	(1033)	3402	(1037)	3420	(1042)	3370-3402	(1027-1037)
23	(7.0)	3322	(1013)	3368	(1027)	3437	(1048)	3452	(1052)	3478	(1060)	3429-3452	(1045-1052)

Location	Well Name	K.B.		T.D.		Dawson Bay Top		Dawson Bay Thickness	
		ft	m	ft	m	ft	m	ft	m
4-28-30-23W2	S W P Boulder Lake 4 28 30 23	1673	(510)	4004	(1220)	3277	(999)	171	(52.1)
15-30-30-23W2	S.W.P. Boulder Lake 15 30 30 23	1668	(508)	3771	(1149)	3250	(991)	169	(51.5)
1-34-30-23W2	Scurry Boulder Lake 1 34 30 23	1681	(512)	3592	(1095)	3253	(992)	169	(51.5)
1-36-30-23W2	Scurry Boulder Lake 1 36 30 23	1697	(518)	3571	(1088)	3248	(990)	166	(50.6)
16-4-31-23W2	Scurry Boulder Lake 16 4 31 23	1700	(518)	3810	(1161)	3247	(990)	145	(44.2)
16-6-31-23W2	Scurry Boulder Lake 16 6 31 23	1674	(510)	3756	(1145)	3222	(982)	138	(42.1)
6-10-31-23W2	Pheas Chevron Boulder L6A 10 31 23	1700	(518)	4107	(1252)	3220	(982)	126	(38.4)
8-2-33-23W2	Alwinsal Huron 8 2	1741	(531)	3361	(1024)	3063	(934)	130	(39.6)
8-3-33-23W2	Alwinsal Lanigan 8 3 33 23	1741	(531)	3905	(1190)	3073	(937)	139	(42.4)
21-12-4-33-23W2	Alwinsal Blood 12 4	1735	(529)	3411	(1040)	3090	(942)	138	(42.1)
31-12-4-33-23W2	Alwinsal Mic Mac 12 4	1732	(528)	3312	(1010)	3089	(942)	137	(41.8)
13-11-33-23W2	Alwinsal Harris 13 11	1743	(531)	3353	(1022)	3079	(939)	133	(40.5)
12-16-33-23W2	Alwinsal Cherokee 12 16	1745	(532)	3353	(1022)	3066	(935)	126	(38.4)
1-20-33-23W2	Alwinsal Lanigan 1 20	1748	(533)	5213	(1589)	3100	(945)	148	(45.1)
9-22-33-23W2	Alwinsal Blackfoot 9 22	1757	(536)	3379	(1030)	3072	(936)	129	(39.3)
9-26-33-23W2	Alwinsal Lanigan 9 26	1763	(537)	3515	(1071)	3010	(917)	133	(40.5)
11-4-28-33-23W2	Alwinsal Sarcee 4 28	1771	(540)	3203	(976)	3083	(940)	130	(39.6)
21-4-28-33-23W2	Winsal Guernsey No. 4 28	1768	(539)	3386	(1032)	3090	(942)	130	(39.6)
5-28-33-23W2	Pilot for shaft	1768	(539)	3319	(1012)	3054	(931)	132	(40.2)
2-30-33-23W2	Alwinsal Dog-rib 2 30	1768	(539)	3433	(1046)	3143	(958)	144	(43.9)
13-30-33-23W2	Alwinsal Louise 13A 30	1768	(539)	3420	(1042)	3090	(942)	138	(42.1)
13-34-33-23W2	Imperial Guernsey 13 34 33 23	1791	(546)	5253	(1601)	3085	(940)	142	(43.3)
3-10-34-23W2	Alwinsal Dellwood 3 10	1786	(544)	3365	(1026)	3039	(926)	138	(42.1)
12-24-34-23W2	Dominion Potash Attica No. 12 24	1802	(549)	3327	(1014)	3009	(917)	132	(40.2)
4-18-35-23W2	Dominion Potash Burr No. 4 18	1844	(562)	3404	(1036)	3027	(923)	122	(37.2)
12-19-36-23W2	Arco Humboldt 12 19 36 23	1821	(555)	4006	(1221)	2949	(899)	131	(39.9)
4-16-29-24W2	Sohio Allenbee Venn 4 16 29 24	1675	(511)	4510	(1375)	3506	(1069)	116	(35.4)
15-16-29-24W2	Venn No. 1	1677	(511)	4417	(1346)	3800	(1158)	173	(52.7)
4-28-29-24W2	Venn No. 2	1696	(517)	4400	(1341)	3502	(1067)	132	(40.2)
8-24-30-24W2	S W P Boulder Lake 8 24 30 24	1663	(507)	3815	(1663)	3273	(998)	142	(43.3)
8-25-30-24W2	S W P Boulder Lake 8 25 30 24	1664	(507)	3815	(1663)	3274	(998)	147	(44.8)
5-14-31-24W2	Campana Watrous No. 5 14	1687	(514)	3562	(1086)	3233	(985)	127	(38.7)
4-16-31-24W2	Campana Watrous No. 4 16	1709	(521)	3662	(1116)	3390	(1033)	115	(35.1)
4-20-31-24W2	Campana Watrous No. 4 20	1721	(525)	3751	(1143)	3430	(1045)	120	(36.6)
8-29-31-24W2	Campana Watrous No. 8 29	1708	(521)	3883	(1184)	3297	(1005)	135	(41.1)
15-33-31-24W2	Campana Watrous No. 15 33	1678	(511)	3560	(1085)	3211	(979)	125	(38.1)
4-10-32-24W2	Campana Watrous No. 4 10	1728	(527)	3545	(1081)	3195	(974)	145	(44.2)
1-10-33-24W2	Alwinsal Mohawk 1 10	1752	(534)	3454	(1053)	3138	(957)	152	(46.3)
11-1-12-33-24W2	Alwinsal Apache 1 12	1749	(533)	3491	(1064)	3123	(952)	139	(42.4)
12-1-12-33-24W2	Alwinsal Beaver 1 12	1749	(533)	3248	(990)	3123	(952)	139	(42.4)
4-24-33-24W2	Alwinsal Guernsey 4 24	1761	(537)	3651	(1113)	3100	(945)	119	(36.3)
6-29-33-24W2	Alwinsal South Wolverine 6 29	1802	(549)	3425	(1044)	3168	(966)	126	(38.4)
9-34-33-24W2	Alwinsal Sioux 9 34	1770	(540)	3403	(1037)	3093	(943)	126	(38.4)
16-12-34-24W2	Duval Potash Wolverine 16 12 34 24	1779	(542)	3371	(1027)	3078	(938)	137	(41.8)
5-11-37-24W2	B.A. Carmel Pappenfoot 5 11 37 24	1883	(574)	3126	(953)	2840	(866)	117	(35.7)
8-12-37-24W2	Tacoma Morrison Humboldt 8 12 37 24	1868	(569)	3760	(1146)	2828	(862)	118	(36.0)
12-22-30-25W2	S W P Amazon 12 22 30 25	1759	(547)	4351	(1326)	3672	(1119)	138	(42.1)
13-11-31-25W2	Sohio Standard Watrous No. 1	1810	(552)	4350	(1326)	3472	(1058)	123	(37.5)
13-24-31-25W2	Campana Watrous No. 13 24	1768	(539)	3867	(1179)	3456	(1053)	128	(39.0)
8-36-31-25W2	Campana Watrous No. 8 36	1741	(531)	3761	(1146)	3428	(1045)	130	(39.6)
4-2-32-25W2	Community Service Watrous No. 1	1774	(541)	3863	(1177)	3715	(1132)	145	(44.2)
10-21-32-25W2	Alwinsal Iroquois 10 21	1773	(540)	3678	(1121)	3318	(1011)	145	(44.2)
15-20-33-25W2	Sohio Plunkett No. 2	1840	(561)	4160	(1268)	3235	(986)	125	(38.1)
1-15-34-25W2	Plunkett No. 1	1845	(562)	4925	(1501)	3214	(980)	154	(46.9)
5-18-34-25W2	Duval Potash Co Viscount 5 18 34 25	1857	(566)	3541	(1079)	3363	(1025)	117	(35.7)
4-13-35-25W2	Dafoe Wolverine 4 13 35 25	1809	(551)	3412	(1040)	3073	(937)	122	(37.2)

Hubbard Mbr. Thickness		Neely Mbr. Top		Burr Mbr. Top		Second Red Bed Mbr. Top		Prairie Evaporite Top		Patience Lake Mbr. Top		Dawson Bay Cored Intervals	
ft	m	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m
37	(11.3)	3314	(1010)	3365	(1025)	3434	(1047)	3448	(1051)	3466	(1056)	3356-3448	(1023-1051)
37	(11.3)	3287	(1002)	3342	(1019)	3404	(1038)	3419	(1042)	3440	(1048)	3410-3419	(1039-1042)
37	(11.3)	3290	(1003)	3342	(1019)	3409	(1039)	3422	(1043)	3446	(1050)	3410-3422	(1039-1043)
35	(10.7)	3283	(1001)	3332	(1016)	3400	(1036)	3414	(1041)	3432	(1046)	3410-3414	(1039-1041)
5	(1.5)	3252	(991)	3303	(1007)	3378	(1030)	3392	(1034)	3406	(1038)	3387-3392	(1032-1034)
12	(3.7)	3234	(986)	3282	(1000)	3346	(1020)	3360	(1024)	3376	(1029)	3350-3360	(1021-1024)
trace		3220	(981)	3268	(995)	3332	(1016)	3346	(1020)	3358	(1024)		
		3063	(934)	3114	(949)	3180	(969)	3193	(973)	3206	(977)	3063-3193	(934-973)
5	(1.5)	3078	(938)	3128	(953)	3200	(975)	3212	(979)	3227	(984)		
10	(3.0)	3100	(945)	3144	(958)	3214	(979)	3228	(984)	3247	(989)	3090-3228	(942-984)
9	(2.7)	3098	(944)	3145	(959)	3210	(978)	3226	(983)	no log		3089-3226	(942-983)
5	(1.5)	3084	(940)	3130	(954)	3198	(975)	3212	(979)	3239	(987)	3087-3212	(941-979)
4	(1.2)	3070	(936)	3116	(949)	3180	(969)	3192	(973)	3208	(978)	3068-3192	(935-973)
23	(7.0)	3123	(952)	3168	(966)	3232	(985)	3248	(990)	3267	(996)		
3	(0.9)	3075	(937)	3124	(952)	3189	(972)	3201	(976)	3232	(985)	3073-3201	(937-976)
		3010	(917)	3057	(932)	3130	(954)	3143	(958)	3163	(964)	3137-3143	(956-958)
		3083	(940)	3132	(955)	3200	(975)	3213	(979)E	—	—	3083-3213	(940-979)
		3090	(942)	3142	(958)	3206	(977)	3220	(981)	3239	(987)	3091-3220	(942-981)
		3054	(931)	3107	(947)	3171	(967)	3186	(971)	3205	(977)		
25	(7.6)	3168	(966)	3214	(980)	3273	(998)	3287	(1002)	3300	(1006)	3144-3287	(958-1002)
10	(3.0)	3100	(945)	3148	(959)	3212	(979)	3228	(984)	3249	(990)	3219-3228	(981-984)
8	(2.4)	3093	(943)	3150	(960)	3212	(979)	3227	(984)	3285	(1001)	3085-3110	(940-948)
7	(2.1)	3046	(928)	3096	(944)	3162	(964)	3177	(968)	3198	(975)	3039-3177	(926-968)
8	(2.4)	3017	(920)	3062	(933)	3128	(953)	3141	(957)	3173	(967)		
		3027	(923)	3072	(936)	3135	(956)	3149	(960)	3178	(969)	3027-3149	(923-960)
12	(3.7)	2961	(903)	3008	(916)	3065	(934)	3080	(939)	3119	(951)		
		3506	(1069)	3548	(1081)	3608	(1100)	3622	(1104)	3637	(1109)	3506-3523	(1069-1074)
		3800	(1158)	3848	(1173)	3958	(1206)	3973	(1211)	Absent			
		3502	(1067)	3550	(1082)	3618	(1103)	3634	(1108)	3634	(1108)	3524-3551	(1074-1082)
15	(4.6)	3288	(1002)	3338	(1017)	3401	(1037)	3415	(1041)	3444	(1050)	3384-3415	(1031-1041)
22	(6.7)	3296	(1005)	3345	(1020)	3408	(1039)	3421	(1043)	3447	(1051)	3417-3421	(1042-1043)
		3233	(985)	3280	(1000)	3345	(1020)	3360	(1024)	3376	(1029)	3233-3260	(985-994)
		3390	(1033)	3430	(1045)	3491	(1064)	3505	(1068)	3523	(1074)	3390-3486	(1033-1063)
												3493-3505	(1065-1068)
		3430	(1045)	3473	(1059)	3535	(1077)	3550	(1082)	3580	(1091)		
		3297	(1005)	3357	(1023)	3417	(1042)	3432	(1046)	3475	(1059)		
		3211	(979)	3259	(993)	3321	(1012)	3336	(1017)	3377	(1029)		
15	(4.6)	3210	(978)	3264	(995)	3326	(1014)	3340	(1018)	3355	(1023)		
20	(6.1)	3158	(963)	3211	(979)	3275	(998)	3290	(1003)	3317	(1011)	3138-3265	(957-995)
												3278-3290	(999-1003)
4	(1.2)	3127	(953)	3177	(968)	3248	(990)	3262	(994)	3288	(1002)	3239-3262	(987-994)
4	(1.2)	3127	(953)	3177	(968)	3248	(990)	3262	(994)	3288	(1002)	3123-3247	(952-990)
6	(1.8)	3106	(947)	3164	(964)	3204	(977)	3219	(981)	3239	(987)	3100-3219	(945-981)
		3168	(966)	3222	(982)	3280	(1000)	3294	(1004)	3305	(1007)	3168-3244	(966-989)
												3277-3294	(999-1004)
		3093	(943)	3141	(957)	3204	(977)	3219	(981)	3249	(990)	3093-3211	(943-979)
												3216-3219	(980-981)
5	(1.5)	3083	(940)	3134	(955)	3202	(976)	3215	(980)	3242	(988)	3078-3209	(938-978)
												3209-3215	(978-980)
		2840	(866)	2884	(879)	2943	(897)	2957	(901)	2968	(905)	2947-2957	(898-901)
		2828	(862)	2869	(874)	2932	(894)	2946	(898)	2957	(899)		
12	(3.7)	3684	(1123)	3735	(1138)	3797	(1157)	3810	(1161)	3828	(1167)		
		3472	(1058)	3517	(1072)	3578	(1091)	3595	(1096)	3624	(1106)		
		3456	(1053)	3500	(1067)	3568	(1088)	3584	(1092)	3599	(1097)		
		3428	(1045)	3474	(1059)	3540	(1079)	3558	(1084)	3565	(1087)		
10	(3.0)	3725	(1135)	3775	(1151)E	3843	(1171)E	3860	(1177)	—	—	3828-3854	(1167-1175)
32	(9.8)	3350	(1021)	3396	(1035)	3449	(1051)	3463	(1056)	3484	(1062)	3318-3448	(1012-1051)
												3453-3463	(1052-1056)
10	(3.0)	3245	(989)	3280	(1000)	3347	(1020)	3360	(1024)	3384	(1031)		
20	(6.1)	3234	(986)	3285	(1001)	3351	(1021)	3368	(1027)	Absent?			
		3363	(1025)	3409	(1039)	3472	(1058)	3480	(1063)	Absent?		3363-3480	(1025-1061)
		3073	(937)	3120	(951)	3181	(970)	3195	(974)	3222	(982)	3187-3195	(971-974)

Location	Well Name	K.B.		T.D.		Dawson Bay Top		Dawson Bay Thickness	
		ft	m	ft	m	ft	m	ft	m
4-16-35-25W2	Dafoe Wolverine 4 16 35 25	1815	(563)	3473	(1059)	3138	(957)	138	(42.1)
13-24-35-25W2	Dafoe Wolverine 13 24 35 25	1836	(560)	3873	(1180)	3035	(925)	138	(42.1)
1-35-35-25W2	Dafoe Wolverine 1 35 35 25	1829	(557)	3417	(1042)	3060	(933)	132	(40.2)
6-15-36-25W2	White Rose C and E Carmel 6 15 36 25	1791	(546)	3920	(1195)	2953	(900)	123	(37.5)
4-21-36-25W2	Imp Seminole 4 21 36 25	1840	(561)	3375	(1029)	3002	(915)	135	(41.1)
16-34-36-25W2	Pheas Arco S Bruno 16 34 36 25	1803	(550)	3750	(1143)	2925	(892)	135	(41.1)
12-18-33-26W2	Shell Young 12 18 33 26	1826	(557)	3631	(1107)	3303	(1007)	131	(39.9)
4-29-33-26W2	Shell Young 4 29 33 26	1819	(554)	3613	(1101)	3292	(1003)	136	(41.5)
5-31-33-26W2	Shell Young 5 31 33 26	1821	(555)	3705	(1129)	3346	(1020)	152	(46.3)
4-6-35-26W2	Noranda Viscount 4 6 35 26	1766	(538)	3456	(1053)	3128	(953)	123	(37.5)
1-12-35-26W	Pheas Banff Viscount 1 12 35 26	1831	(559)	3961	(1207)	3162	(964)	125	(38.1)
4-19-35-26W2	Noranda Rutan 4 19 35 26	1762	(537)	3325	(1013)	3017	(920)	120	(36.6)
4-19-36-26W2	Imp Saxby 4 19 36 26	1792	(546)	3325	(1013)	2978	(908)	126	(38.4)
4-29-39-26W2	Pheas Shell Bremen 4 29 39 26	1864	(568)	3548	(1081)	2852	(869)	126	(38.4)
15-32-31-27W2	Pheas Baoh Watrous 15 32 31 27	1804	(550)	4324	(1318)	3535	(1077)	134	(40.8)
15-11-32-27W2	Young No. 1	1758	(536)	4318	(1316)	3380	(1030)	120	(36.6)
9-2-33-27W2	Shell Young 9 2 33 27	1766	(538)	3576	(1090)	3260	(994)	152	(46.3)
10-22-33-27W2	Shell Young 10 22 33 27	1776	(541)	3629	(1106)	3285	(1001)	148	(45.1)
4-10-34-27W2	Noranda Neely 4 10 34 27	1778	(542)	3566	(1087)	3232	(985)	144	(43.9)
8-12-34-27W2	Noranda Viscount 8 12 34 27	1792	(546)	3537	(1078)	3223	(982)	145	(44.2)
31-16-15-34-27W2	Noranda Neely 16 15 34 27	1791	(546)	3515	(1071)	3144	(958)	139	(42.4)
31-16-15-34-27W2	Noranda Neely 16A 15 34 27	1791	(546)	3360	(1024)	3150	(960)	137	(41.8)
11-6-16-34-27W2	Noranda Neely 6 16 34 27	1772	(540)	3498	(1066)	3148	(960)	124	(37.8)
11-6-16-34-27W2	Noranda Neely 6A 16 34 27	1772	(540)	3360	(1024)	3148	(960)	125	(38.1)
9-20-34-27W2	Cons. Morrison Neely 9 20 34 27	1784	(544)	3436	(1047)	3138	(957)	136	(41.5)
2-21-34-27W2	CCP Viscount 1 Disposal 2 21 34 27	1790	(546)	5355	(1632)	3193	(973)	137	(41.8)
16-21-34-27W2	Noranda Neely 16 21 34 27	1806	(550)	3500	(1067)	3188	(972)	126	(38.4)
12-24-34-27W2	Duval Potash Co Viscount 12 24 34 27	1792	(546)	3478	(1060)	3170	(966)	132	(40.2)
9-27-34-27W2	Noranda Neely 9 27 34 27	1781	(543)	3473	(1059)	3135	(956)	128	(39.0)
5-29-34-27W2	Noranda Neely 5 29 34 27	1805	(550)	3466	(1056)	3143	(958)	134	(40.8)
5-33-34-27W2	Cons Morrison Colonsay 5 33 34 27	1789	(545)	3460	(1057)	3157	(962)	127	(38.7)
5-4-35-27W2	Consolidated Morrison Colonsay 5 4	1801	(549)	3373	(1028)	3128	(953)	130	(39.6)
4-14-35-27W2	Duval Potash Co Rutan 4 14 35 27	1740	(530)	3411	(1040)	3110	(948)	120	(36.6)
13-16-35-27W2	Noranda Rutan 13 16 35 27	1825	(556)	3479	(1060)	3159	(963)	129	(39.3)
16-32-36-27W2	Imp Meacham 16 32 36 27	1897	(578)	3475	(1059)	3066	(935)	130	(39.6)
15-34-37-27W2	Kennco Peterson 15 34 37 27	1902	(580)	3377	(1029)	3018	(920)	121	(36.9)
3-27-38-27W2	Kennco Prudhomme 3 27 38 27	1994	(608)	3315	(1010)	3020	(920)	123	(37.5)
16-6-39-27W2	Shell Prudhomme 16 6 39 27	1831	(558)	3756	(1145)	2973	(906)	123	(37.5)
1-17-27-28W2	IW Allenbee Nash 1 17 27 28	1860	(567)	5827	(1775)	4180	(1274)	122	(37.2)
6-24-30-28W2	HB Watrous 6 24 30 28	2073	(632)	6115	(1864)	3897	(1188)	129	(39.3)
8-35-30-28W2	HB Watrous 8 35 30 28	1941	(592)	5580	(1701)	3704	(1129)	136	(41.5)
16-36-30-28W2	Kerr-McGee Horseshoe 16 36 30 28	1916	(584)	4137	(1261)	3690	(1125)	128	(39.0)
4-22-32-28W2	Thomson Young 4 22 32 28	1765	(538)	3760	(1146)	3420	(1042)	128	(39.0)
4-29-32-28W2	Placid Allan 4 29 32 28	1800	(549)	3930	(1198)	3449	(1050)	133	(40.5)
13-33-32-28W2	Jagor Columbian Young 13 33 32 28	1786	(544)	3711	(1131)	3452	(1051)	132	(40.2)
15-34-32-28W2	Kennco 1 — Young 15 34 32 28	1764	(538)	3719	(1134)	3370	(1027)	135	(41.1)
16-33-33-28W2	US Borax Chem Corp Zelma 16 33 33 28	1712	(522)	3480	(1061)	3190	(972)	128	(39.0)
12-11-35-28W2	Duval Potash Co Colonsay 12 11 35 28	1754	(535)	3391	(1034)	3130	(954)	122	(37.2)
16-24-35-28W2	Noranda Colonsay 16 24 35 28	1792	(546)	3400	(1036)	3096	(944)	122	(37.2)
16-36-36-28W2	White Rose et al Trojan 16 36 36 28	1860	(567)	4050	(1234)	3010	(917)	120	(36.6)
1-4-37-28W2	Imperial South Bend 1 4 37 28	1924	(586)	3525	(1074)	3168	(966)	121	(36.9)
1-15-37-28W2	Imp Southbend 1 15 37 28	1891	(577)	3450	(1052)	3105	(946)	127	(38.7)
12-10-38-28W2	Kennco 3 Prudhomme 12 10 38 28	1846	(563)	3243	(988)	2950	(899)	117	(35.7)
11-12-38-28W2	SPC Prudhomme 11 12 38 28	1922	(586)	3555	(1084)	3036	(925)	118	(36.0)
11-12-38-28W2	S.P.C. Prudhomme 11 12 38 28	1887	(575)	3500	(1067)	2972	(906)	118	(36.0)
6-36-38-28W2	Shell Prudhomme 6 36 38 28	1831	(558)	3810	(1161)	2922	(891)	119	(36.3)
15-36-32-29W2	Kennco 2-Young 15 36 32 29	1762	(537)	3806	(1160)	3490	(1064)	131	(39.9)
9-29-30-1W3	Gridoil Kenaston 9 29 30 1	2137	(651)	5040	(1536)	4030	(1228)	133	(40.5)
2-15-32-1W3	Pheas Gridoil South Allan 2 15 32 1	2108	(643)	4642	(1415)	3814	(1163)	128	(39.0)
1-29-32-1W3	Arco Allan Creek 1 29 32 1	2001	(610)	4590	(1399)	3780	(1152)	125	(38.1)
4-10-33-1W3	Tide Water Allan Crown No. 1	1762	(537)	4955	(1510)	3472	(1058)	130	(39.6)
16-11-33-1W3	Tide Water Allan Crown No. 16 11	1748	(533)	4236	(1291)	3356	(1023)	116	(35.4)

Hubbard Mbr. Thickness		Neely Mbr. Top		Burr Mbr. Top		Second Red Bed Mbr. Top		Prairie Evaporite Top		Patience Lake Mbr. Top		Dawson Bay Cored Intervals	
ft	m	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m
11	(3.4)	3149	(960)	3201	(975)	3262	(994)	3276	(999)	3316	(1010)	3254-3276	(992-999)
12	(3.7)	3047	(929)	3096	(944)	3158	(963)	3173	(967)	3200	(975)	3154-3173	(961-967)
6	(1.8)	3066	(935)	3115	(950)	3178	(969)	3192	(973)	3225	(983)	3185-3192	(971-973)
		2953	(900)	3003	(915)	3062	(933)	3076	(938)	3117	(950)		
12	(3.7)	3014	(919)	3064	(934)	3123	(952)	3137	(956)	3184	(970)		
12	(3.7)	2937	(895)	2980	(908)	3047	(929)	3060	(933)	3096	(944)		
15	(4.6)	3318	(1011)	3363	(1025)	3422	(1043)	3434	(1047)	3460	(1055)	3429-3434	(1045-1047)
10	(3.0)	3302	(1006)	3355	(1023)	3413	(1040)	3428	(1045)	3474	(1059)		
26	(7.9)	3372	(1028)	3426	(1043)	3484	(1062)	3498	(1066)	Absent		3493-3498	(1065-1066)
trace		3128	(953)	3181	(970)	3239	(987)	3251	(991)	3346	(1020)		
		3162	(964)	3215	(980)	3273	(998)	3287	(1002)	3331	(1026)		
		3017	(920)	3065	(934)	3124	(952)	3137	(956)	3170	(966)	3136-3137	(956-956)
2	(0.6)	2980	(908)	3030	(924)	3090	(942)	3104	(946)	3127	(953)	3091-3104	(942-946)
		2852	(869)	2893	(882)	2958	(902)	2972	(906)	Absent			
		3535	(1077)	3590	(1094)	3656	(1114)	3669	(1118)	3690	(1125)		
		3380	(1030)	3428	(1045)	3486	(1063)	3500	(1067)	3530	(1076)		
24	(7.3)	3284	(1001)	3337	(1017)	3398	(1036)	3412	(1040)	3431	(1046)	3402-3412	(1037-1040)
15	(4.6)	3300	(1006)	3353	(1022)	3420	(1042)	3433	(1046)	3521	(1073)	3426-3433	(1044-1046)
12	(3.7)	3244	(989)	3303	(1007)	3362	(1025)	3376	(1029)	3425	(1044)		
14	(4.3)	3237	(987)	3293	(1004)	3354	(1022)	3368	(1027)	3403	(1038)		
16	(4.9)	3160	(963)	3210	(978)	3270	(997)	3283	(1001)	3306	(1008)		
12	(3.7)	3162	(964)	3212	(979)	3273	(998)	3287	(1002)	3310	(1009)		
		3148	(960)	3200	(975)	3259	(993)	3272	(997)	3305	(1007)		
		3148	(960)	3200	(975)	3260	(994)	3273	(998)	3306	(1007)		
4	(1.2)	3142	(958)	3200	(975)	3261	(994)	3274	(998)	3299	(1006)	3191-3274	(973-998)
10	(3.0)	3203	(976)	3258	(993)	3318	(1011)	3330	(1015)	3388	(1033)	3320-3330	(1012-1015)
		3188	(972)	3240	(988)	3300	(1006)	3314	(1010)	3341	(1018)	3190-3314	(972-1010)
		3170	(966)	3226	(983)	3288	(1002)	3300	(1006)	3339	(1018)	3226-3300	(983-1006)
		3135	(956)	3184	(970)	3249	(990)	3263	(995)	3296	(1005)		
		3143	(958)	3200	(975)	3263	(995)	3277	(999)	3289	(1002)		
		3157	(962)	3205	(977)	3270	(997)	3284	(1001)	3306	(1008)	3157-3284	(962-1001)
10	(3.0)	3138	(956)	3180	(969)	3243	(988)	3258	(993)	3280	(1000)		
		3110	(948)	3163	(964)	3220	(981)	3230	(985)	3281	(1000)	3110-3230	(946-985)
10	(3.0)	3169	(966)	3213	(979)	3274	(998)	3288	(1002)	3312	(1010)		
8	(2.4)	3074	(937)	3122	(952)	3182	(970)	3196	(974)	3212	(979)		
		3018	(920)	3057	(932)	3125	(953)	3139	(957)	3146	(959)	3018-3139	(920-957)
		3020	(920)	3062	(933)	3125	(953)	3143	(958)	3151	(960)	3020-3143	(921-958)
		2973	(906)	3018	(920)	3078	(938)	3096	(944)	Absent			
		4180	(1274)	4226	(1288)	4289	(1307)	4302	(1311)	4318	(1316)		
		3897	(1188)	3952	(1205)	4012	(1223)	4026	(1227)	4045	(1233)		
		3704	(1129)	3762	(1147)	3827	(1166)	3840	(1170)	3855	(1175)		
		3690	(1125)	3742	(1141)	3802	(1159)	3818	(1164)	3895	(1187)	3758-3818	(1146-1164)
		3420	(1042)	3458	(1054)	3533	(1077)	3548	(1081)	3570	(1088)	3540-3548	(1078-1081)
		3449	(1050)	3492	(1064)	3569	(1088)	3582	(1092)	3608	(1100)	3460-3582	(1055-1093)
		3452	(1051)	3500	(1067)	3571	(1088)	3584	(1092)	3609	(1100)		
		3370	(1027)	3432	(1046)	3492	(1064)	3506	(1068)	3519	(1073)	3416-3505	(1041-1068)
		3190	(972)	3242	(988)	3303	(1007)	3318	(1011)	3341	(1018)	3277-3318	(999-1011)
		3130	(954)	3183	(970)	3239	(987)	3252	(991)	3266	(995)	3136-3252	(956-991)
		3096	(944)	3147	(959)	3203	(976)	3218	(981)	3243	(988)	3217-3218	(981-981)
		3010	(917)	3059	(932)	3116	(950)	3130	(954)	3145	(959)		
		3168	(966)	3221	(982)	3276	(999)	3289	(1002)	3336	(1017)	3281-3289	(1000-1002)
		3105	(946)	3159	(963)	3217	(981)	3232	(985)	3260	(994)	3231-3232	(985-985)
		2950	(899)	2992	(912)	3053	(930)	3067	(935)	3072	(937)	2969-3067	(905-935)
		3036	(925)	3081	(939)	3139	(957)	3154	(961)	3181	(970)	3130-3154	(954-961)
		2972	(906)	3015	(919)	3074	(937)	3090	(942)	3108	(947)		
		2922	(891)	2971	(906)	3025	(922)	3041	(927)	3048	(929)		
		3490	(1064)	3534	(1077)	3608	(1100)	3621	(1104)	3637	(1109)	3490-3621	(1064-1104)
		4030	(1228)	4082	(1244)	4151	(1265)	4163	(1269)	4190	(1277)		
		3814	(1163)	3870	(1180)	3930	(1198)	3942	(1202)	3959	(1207)		
		3780	(1152)	3885	(1184)	3892	(1186)	3905	(1190)	3940	(1201)		
		3472	(1058)	3525	(1074)	3585	(1093)	3602	(1098)	3624	(1105)	3489-3511	(1063-1079)
		3356	(1023)	3404	(1038)	3459	(1054)	3472	(1058)	3513	(1071)		

Location	Well Name	K.B.		T.D.		Dawson Bay Top		Dawson Bay Thickness	
		ft	m	ft	m	ft	m	ft	m
13-11-34-1W3	US Borax Chem Corp Allan 13 11 34 1	1735	(529)	3554	(1083)	3243	(988)	133	(40.5)
11-1-12-34-1W3	US Borax Chem Corp Allan 1 12 34 1	1734	(529)	3499	(1066)	3282	(1000)	122	(37.2)
41-1-12-34-1W3	US Borax Chem Corp Allan 1 12A 34 1	1731	(528)	3382	(1031)	3265	(995)	119	(36.3)
16-14-34-1W3	US Borax Chem Corp Allan 16 14 34 1	1720	(524)	3550	(1082)	3233	(985)	126	(38.4)
1-17-34-1W3	US Borax Chem Corp Allan 1 17 34 1	1750	(533)	3572	(1089)	3274	(998)	125	(38.1)
5-22-34-1W3	US Borax Chem Corp Elstow 5 22A 34 1	1731	(528)	3605	(1099)	3232	(985)	129	(39.3)
13-22-34-1W3	APM Allan Disposal D13 22 34 1	1720	(524)	4670	(1423)	3165	(965)	128	(39.0)
15-24-34-1W3	Altair Elstow 15 24	1731	(528)	4201	(1280)	3262	(994)	121	(36.9)
1-25-34-1W3	US Borax Chem Corp Elstow 1 25 34 1	1742	(531)	3612	(1101)	3283	(1001)	127	(38.7)
9-26-34-1W3	US Borax Chem Corp Elstow 9 26 34 1	1735	(529)	3509	(1070)	3196	(974)	125	(38.1)
9-27-34-1W3	US Borax Chem Corp Elstow 9 27 34 1	1735	(529)	3474	(1059)	3180	(969)	125	(38.1)
9-28-34-1W3	US Borax Chem Corp Elstow 9 28 34 1	1727	(526)	3477	(1060)	3179	(969)	127	(38.7)
21-4-29-34-1W3	US Borax Chem Corp Elstow 4 29 34 1	1733	(528)	3519	(1073)	3204	(977)	125	(38.1)
22-4-29-34-1W3	US Borax and Chem Elstow 4 29A 34 1	1736	(529)	3519	(1073)	3207	(978)	119	(36.3)
9-33-34-1W3	US Borax Chem Corp Elstow 9 33 34 1	1731	(528)	3471	(1058)	3162	(964)	128	(39.0)
8-34-34-1W3	US Borax Chem Corp Elstow 8 34 34 1	1717	(523)	3455	(1053)	3164	(964)	116	(35.4)
9-35-34-1W3	US Borax Chem Corp Elstow 9 35 34 1	1727	(526)	3462	(1055)	3155	(962)	120	(36.6)
16-9-35-1W3	Elstow 16 9	1733	(528)	3457	(1054)	3115	(949)	134	(40.8)
5-26-35-1W3	Elstow No. 5 26	1779	(542)	3508	(1069)	3200	(975)	121	(36.9)
9-29-36-1W3	U S P St Denis No. 1	1845	(562)	3462	(1055)	3140	(957)	128	(39.0)
4-16-37-1W3	White Rose et al St Denis 4 16 37 1	1833	(559)	5415	(1650)	3107	(947)	116	(35.4)
1-22-37-1W3	White Rose St Denis 1 22 37 1	1830	(558)	3993	(1217)	3039	(926)	118	(36.0)
13-33-37-1W3	U S P Vonda No. 1 A	1833	(574)	3395	(1035)	3086	(941)	114	(34.7)
7-2-38-1W3	White Rose et al St Denis 7 2 38 1	1927	(587)	4067	(1240)	3036	(925)	121	(36.9)
6-16-38-1W3	White Rose et al St Denis 6 16 38 1	1937	(590)	4025	(1227)	3016	(919)	119	(36.3)
9-29-33-2W3	US Borax Chem Co Bradwell 9 29 33 2	1767	(539)	3645	(1111)	3352	(1022)	125	(38.1)
16-11-34-2W3	US Borax Chem Co Bradwell 16 11 34 2	1773	(540)	3650	(1113)	3333	(1016)	120	(36.6)
12-32-34-2W3	U S P Bradwell No. 1	1759	(536)	3657	(1115)	3316	(1011)	135	(41.1)
5-34-35-2W3	P C A Saskatoon No. 8	1731	(528)	3220	(981)	3115	(949)	119	(36.3)
12-7-36-2W3	PCA Saskatoon No. 4	1778	(542)	3595	(1096)	3244	(989)	121	(36.9)
4-22-36-2W3	P C A Saskatoon No. 7	1856	(566)	3538	(1078)	3218	(981)	122	(37.2)
3-30-37-2W3	Duval Aberdeen 3 30 37 2	1776	(542)	3383	(1031)	3079	(938)	116	(35.4)
4-2-38-2W3	Arco St Denis 4 2 38 2	1868	(569)	3990	(1216)	3120	(951)	120	(36.6)
13-11-34-3W3	US Borax Chem Co Bradwell 13 11	1745	(532)	3721	(1134)	3430	(1045)	119	(36.3)
14-23-34-3W3	Bison Bradwell 14 23 34 3	1761	(537)	3558	(1084)	3364	(1025)	122	(37.2)
5-34-34-3W3	Anglo American Gridoil Clavet 5 34	1752	(534)	4290	(1308)	3490	(1064)	126	(38.4)
1-34-35-3W3	PCA Saskatoon No. 6	1716	(523)	3428	(1045)	3333	(1016)	111	(33.8)
13-2-36-3W3	P C A Saskatoon No. 9	1742	(531)	3475	(1059)	3174	(967)	121	(36.9)
11-9-36-3W3	PCA Saskatoon 11 9 36 3	1765	(538)	3309	(1009)	3198	(975)	122	(37.2)
6-16-36-3W3	P.C.A. Saskatoon No. 2	1740	(531)	3745	(1141)	3150	(960)	120	(36.6)
3-18-36-3W3	P C A Saskatoon No. 11	1785	(544)	3593	(1095)	3263	(995)	123	(37.5)
13-24-36-3W3	Potash Co of America Saskatoon No. 5	1742	(531)	3553	(1083)	3183	(970)	119	(36.3)
4-4-37-3W3	P C A Saskatoon No. 10	1782	(543)	3454	(1053)	3135	(956)	113	(34.4)
16-17-37-3W3	Saskatoon 16 17	1946	(593)	3571	(1088)	3244	(989)	125	(38.1)
12-5-38-3W3	Placid Arco Vonda 12 5 38 3	1755	(535)	3890	(1186)	2934	(894)	116	(35.4)
14-8-32-4W3	Pheas Noel Dundurn 14 8 32 4	1728	(527)	4430	(1350)	3595	(1096)	120	(36.6)
16-20-32-4W3	Pheas Noel Pan Am Dundurn 16 20 32 4	1807	(551)	4420	(1347)	3617	(1102)	122	(37.2)
16-26-36-4W3	Potash America Saskatoon 16 26 36 4	1807	(551)	3708	(1130)	3320	(1012)	118	(36.0)
16-32-36-4W3	Southwest No. 2	1697	(517)	3618	(1103)	3475	(1059)	117	(35.7)
15-9-37-4W3	Southwest No. 3	1686	(514)	3400	(1036)	3078	(938)	115	(35.1)
12-19-37-4W3	Saskatoon No. 12 19	1645	(501)	3448	(1051)	3170	(966)	113	(34.4)
13-22-37-4W3	Potash America Saskatoon 13 22 37 4	1669	(509)	3350	(1021)	2950	(899)	114	(34.7)
6-25-37-4W3	Amco No. 1	1713	(522)	3300	(1006)	2950	(899)	111	(33.8)
6-12-38-4W3	General Petroleums Saskatoon 6 12	1671	(509)	3234	(986)	2854	(870)	114	(34.7)
16-24-39-4W3	Grt Plns Decalta Osler 16 24 39 4	1623	(495)	3565	(1087)	2722	(830)	120	(36.6)
3-28-39-4W3	Winsal Osler 3 28	1708	(521)	3336	(1017)	2806	(855)	119	(36.3)
13-36-41-4W3	Britalta Rosthern No. 1	1724	(525)	3520	(1073)	2615	(797)	117	(35.7)
12-10-29-5W3	TW Placid Hawarden Cr 12 10 29 5	2014	(614)	5666	(1727)	4462	(1360)	137	(41.8)

Hubbard Mbr. Thickness		Neely Mbr. Top		Burr Mbr. Top		Second Red Bed Mbr. Top		Prairie Evaporite Top		Patience Lake Mbr. Top		Dawson Bay Cored Intervals	
ft	m	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m
		3243	(988)	3304	(1007)	3363	(1025)	3376	(1029)	3398	(1035)	3340-3376	(1018-1029)
		3282	(1000)	3331	(1015)	3392	(1034)	3404	(1038)	3429	(1045)		
		3265	(995)	3310	(1009)	3370	(1027)	3384	(1031)E	—	—	3274-3386	(998-1032)
		3233	(985)	3286	(1002)	3346	(1020)	3359	(1024)	3392	(1034)	3249-3359	(990-1024)
		3274	(998)	3314	(1010)	3386	(1032)	3399	(1036)	3424	(1044)	3283-3399	(1001-1036)
		3232	(985)	3287	(1002)	3346	(1020)	3361	(1024)	3390	(1033)	3232-3361	(985-1024)
		3165	(965)	3220	(981)	3280	(1000)	3293	(1004)	3321	(1012)		
		3262	(994)	3366	(1026)	3371	(1027)	3383	(1031)	3423	(1043)		
		3283	(1001)	3336	(1017)	3398	(1036)	3410	(1039)	3447	(1051)	3283-3319	(1001-1012)
												3388-3410	(1033-1039)
		3196	(974)	3250	(991)	3309	(1009)	3321	(1012)	3349	(1021)	3213-3321	(979-1012)
		3180	(969)	3230	(985)	3292	(1003)	3305	(1007)	3329	(1015)	3195-3305	(974-1007)
		3179	(969)	3230	(985)	3293	(1004)	3306	(1008)	3323	(1013)	3189-3306	(972-1008)
		3204	(977)	3259	(993)	3315	(1010)	3329	(1015)	3364	(1025)	3214-3329	(980-1015)
		3207	(977)	3253	(992)	3312	(1010)	3326	(1014)E	3361	(1024)E	3213-3320	(979-1012)
		3162	(964)	3216	(980)	3276	(999)	3290	(1003)	3309	(1009)	3185-3290	(971-1003)
		3164	(964)	3207	(977)	3266	(995)	3280	(1000)	3307	(1008)	3165-3280	(965-1000)
		3155	(962)	3197	(974)	3262	(994)	3275	(998)	3291	(1003)	3155-3275	(962-998)
		3115	(949)	3172	(967)	3234	(986)	3249	(990)	3260	(994)	3248-3249	(990-990)
		3200	(975)	3250	(991)	3308	(1008)	3321	(1012)	3379	(1030)	3316-3321	(1011-1012)
		3140	(957)	3204	(977)	3254	(992)	3268	(996)	3302	(1006)		
		3107	(947)	3157	(962)	3211	(979)	3223	(982)	3278	(999)		
		3039	(926)	3085	(940)	3145	(959)	3157	(962)	3183	(970)		
		3086	(941)	3127	(953)	3187	(971)	3200	(975)	3208	(977)		
		3036	(925)	3087	(941)	3142	(958)	3157	(962)	3159	(963)		
		3016	(919)	3065	(934)	3121	(951)	3135	(956)	3140	(957)		
		3352	(1022)	3400	(1036)	3465	(1056)	3477	(1060)	3495	(1065)	3450-3477	(1052-1060)
		3333	(1016)	3384	(1031)	3440	(1049)	3453	(1052)	3505	(1068)	3423-3453	(1043-1052)
		3316	(1011)	3370	(1027)	3438	(1048)	3451	(1052)	3481	(1061)	3425-3451	(1044-1052)
		3115	(949)	3160	(963)	3220	(981)	3234	(986)	3248	(990)	3220-3234	(981-986)
		3244	(989)	3295	(1004)	3353	(1022)	3365	(1026)	3392	(1034)	3244-3365	(989-1026)
		3218	(981)	3270	(997)	3327	(1014)	3340	(1018)	3350	(1021)	3330-3340	(1015-1018)
		3079	(938)	3133	(955)	3182	(970)	3195	(974)	3245	(989)	3140-3195	(957-974)
		3120	(951)	3170	(966)	3228	(984)	3240	(988)	3261	(994)		
		3430	(1045)	3478	(1060)	3537	(1078)	3549	(1082)	3591	(1095)	3522-3549	(1074-1082)
		3364	(1025)	3415	(1041)	3473	(1059)	3486	(1063)	3522	(1074)	3468-3486	(1057-1063)
		3490	(1064)	3535	(1077)	3598	(1097)	3616	(1102)	3628	(1106)		
		3333	(1016)	3376	(1029)	3432	(1046)	3444	(1050)	3505	(1068)	3428-3444	(1045-1050)
		3174	(967)	3223	(982)	3282	(1000)	3295	(1004)	3310	(1009)		
		3198	(975)	3248	(990)	3307	(1008)	3320	(1012)E	—	—	3209-3305	(978-1007)
		3150	(960)	3206	(977)	3258	(993)	3270	(997)	3292	(1003)	3150-3270	(960-997)
		3263	(995)	3317	(1011)	3373	(1028)	3386	(1032)	3411	(1040)	3263-3310	(995-1009)
												3371-3386	(1027-1032)
		3183	(970)	3238	(987)	3289	(1002)	3302	(1006)	3335	(1017)	3185-3302	(971-1006)
		3135	(956)	3182	(970)	3233	(985)	3248	(990)	3274	(998)	3135-3183	(955-970)
												3246-3248	(989-990)
		3244	(989)	3301	(1006)	3355	(1023)	3369	(1027)	3390	(1033)	3360-3369	(1024-1027)
		2934	(894)	2977	(907)	3036	(925)	3050	(930)	3053	(931)		
		3595	(1096)	3650	(1113)	3702	(1128)	3715	(1132)	3771	(1149)		
		3617	(1102)	3663	(1116)	3725	(1135)	3739	(1140)	3792	(1156)		
		3320	(1012)	3360	(1024)	3422	(1043)	3438	(1048)	3448	(1051)		
		3475	(1059)	3523	(1074)	3572	(1089)	3592	(1095)	Absent		3588-3592	(1094-1095)
		3078	(938)	3125	(953)	3180	(969)	3193	(973)	3200	(975)	3175-3193	(968-973)
		3170	(966)	3218	(981)	3270	(997)	3283	(1001)	3294	(1004)	3278-3283	(999-1001)
		2950	(899)	2995	(913)	3050	(930)	3064	(934)	3073	(937)	3062-3064	(933-934)
		2950	(899)	2987	(910)	3048	(929)	3061	(933)	3067	(935)		
		2854	(870)	2900	(884)	2952	(900)	2968	(905)	2968	(905)	2934-2968	(894-905)
		2722	(830)	2772	(845)	2823	(860)	2842	(866)	Absent			
		2806	(855)	2848	(868)	2908	(886)	2925	(892)	Absent			
		2615	(797)	2666	(813)	2714	(827)	2732	(833)	Absent			
		4462	(1360)	4510	(1375)	4585	(1398)	4599	(1402)	Absent		4462-4500	(1360-1372)
												4584-4599	(1397-1402)

Location	Well Name	K.B.		T.D.		Dawson Bay Top		Dawson Bay Thickness	
		ft	m	ft	m	ft	m	ft	m
5-35-31-5W3	Great Canadian Dundurn 5 35 31 5	1726	(526)	4446	(1355)	3620	(1103)	122	(37.2)
9-4-32-5W3	Great Canadian Dundurn 9 4 32 5	1729	(527)	3972	(1211)	3636	(1108)	121	(36.9)
10-7-32-5W3	Goldfield Grt Cdn Dundurn 10 7 32 5	1716	(523)	3983	(1214)	3574	(1089)	132	(40.2)
8-17-32-5W3	Dundurn Crown No. 2	1731	(528)	5066	(1544)	3528	(1075)	127	(38.7)
13-18-32-5W3	Imperial Dundurn 13 18 32 5	1703	(519)	3895	(1187)	3568	(1088)	128	(39.0)
12-20-32-5W3	Goldfield Grt Cdn Dundurn 12 20 32 5	1711	(522)	3863	(1177)	3493	(1065)	125	(38.1)
4-26-37-5W3	Northern Rochdale 4 26 37 5	1654	(504)	3695	(1126)	3153	(961)	109	(33.2)
16-16-38-5W3	B.A. Warman 16 16 38 5	1680	(515)	3213	(979)	2923	(891)	111	(33.8)
9-29-41-5W3	Shell Waldheim 9 29 41 5	1786	(544)	3500	(1067)	2818	(859)	120	(36.6)
14-21-31-6W3	Imperial Wingello 14 21 31 6	1710	(521)	4014	(1223)	3642	(1110)	118	(36.0)
4-4-36-6W3	Duval Potash Saskatoon 4 4 36 6	1683	(513)	3550	(1082)	3272	(997)	113	(34.4)
5-7-36-6W3	Duval Corp Saskatoon 5 7 36 6	1630	(497)	3510	(1070)	3198	(975)	114	(34.7)
1-16-36-6W3	Duval Saskatoon 1 16 36 6	1660	(506)	3519	(1073)	3230	(985)	112	(34.1)
6-18-36-6W3	Duval Saskatoon 6 18 36 6	1649	(503)	3961	(1207)	3165	(964)	107	(32.6)
14-28-36-6W3	Midas No. 3	1664	(507)	5320	(1622)	3180	(969)	116	(35.4)
5-30-36-6W3	Duval Saskatoon 5 30 36 6	1663	(507)	3501	(1067)	3197	(974)	112	(34.1)
01-4-2-37-6W3	DSP 4 2 37 6	1659	(506)	3454	(1053)	3134	(955)	112	(34.1)
02-4-2-37-6W3	DSP 4 2A 37 6	1659	(506)	3453	(1052)	3135	(956)	113	(34.4)
15-2-37-6W3	Duval Potash Saskatoon 15 2 37 6	1657	(505)	3486	(1063)	3178	(969)	118	(36.0)
1-34-37-6W3	White Rose et al Cory 1 34 37 6	1682	(513)	4010	(1222)	3182	(970)	120	(36,6)
7-20-30-7W3	Outlook Crown No. 1	1776	(541)	5289	(1612)	3815	(1163)	115	(35.1)
5-20-32-7W3	HB Donavon 5 20 32 7	1755	(535)	4500	(1372)	3644	(1111)	124	(37.8)
2-2-34-7W3	HB Pike Lake 2 2 34 7	1748	(533)	4300	(1311)	3515	(1071)	122	(37.2)
1-25-35-7W3	Duval Saskatoon 1 25 35 7	1664	(507)	3580	(1091)	3280	(1000)	115	(35.1)
16-34-35-7W3	Duval Corp Saskatoon 16 34 35 7	1683	(513)	3595	(1096)	3288	(1002)	118	(36.0)
8-13-36-7W3	Duval Saskatoon SWD 8 13 36 7	1648	(502)	5336	(1626)	3204	(977)	110	(33.5)
4-16-36-7W3	Duval Saskatoon 4 16 36 7	1683	(513)	3570	(1088)	3264	(995)	120	(36.6)
8-22-36-7W3	Duval Potash Saskatoon 8 22 36 7	1681	(512)	3535	(1077)	3242	(988)	112	(34.1)
1-32-36-7W3	Duval Potash Saskatoon 1 32 36 7	1659	(506)	3418	(1042)	3123	(952)	112	(34.1)
1-11-37-7W3	Duval Potash Saskatoon 1 11 37 7	1663	(507)	3427	(1045)	3108	(947)	116	(35.4)
4-28-37-7W3	Duval Potash Saskatoon 4 28 37 7	1678	(511)	3400	(1036)	3068	(935)	116	(35.4)
12-30-38-7W3	Banff et al Langham 12 30 38 7	1679	(512)	5384	(1641)	3038	(926)	114	(34.7)
1-32-38-7W3	Canadian Exp. Ltd. Langham 1 32 38 7	1705	(520)	3204	(977)	2960	(902)	115	(35.1)
16-6-39-7W3	Canex Langham 16 6 39 7	1691	(515)	3208	(978)	2925	(892)	119	(36.3)
16-18-39-7W3	Canex Langham 16 18 39 7	1697	(517)	3170	(966)	2891	(881)	118	(36.0)
9-18-40-7W3	Sohio Standard Langham No. 1	1698	(518)	4001	(1220)	2795	(852)	111	(33.8)
16-19-31-8W3	Fina Conquest N 16 19 31 8	1763	(537)	6215	(1894)	3740	(1140)	108	(32.9)
16-9-32-8W3	Tide Water Swanson Crown No. 2	1753	(534)	5285	(1611)	3666	(1117)	113	(34.4)
16-34-32-8W3	W. James Donovan 16 34 32 8	1740	(530)	4252	(1296)	3638	(1109)	129	(39.3)
16-22-33-8W3	W. James Saskatoon 16 22 33 8	1747	(532)	3869	(1179)	3569	(1088)	115	(35.1)
16-28-34-8W3	C.M. and S. Delisle 16 28 34 8	1736	(529)	3794	(1156)	3500	(1067)	109	(33.2)
15-32-34-8W3	C.M. and S. Delisle 15 32 34 8	1702	(519)	3920	(1195)	3511	(1070)	104	(31.7)
13-1-35-8W3	C.M. and S. Vanscoy 13 1 35 8	1729	(527)	3731	(1137)	3447	(1051)	109	(33.2)
16-6-35-8W3	C.M. and S. Vanscoy 16 6 35 8	1667	(508)	3717	(1133)	3420	(1042)	111	(33.8)
16-8-35-8W3	C.M. and S. Vanscoy 16 8 35 8	1676	(511)	3955	(1205)	3388	(1033)	107	(32.6)
4-10-35-8W3	C.M. and S. Vanscoy 4 10 35 8	1715	(523)	3679	(1122)	3385	(1032)	111	(33.8)
13-11-35-8W3	C.M. and S. Vanscoy 13 11 35 8	1714	(522)	3675	(1120)	3356	(1023)	108	(32.9)
11-16-35-8W3	C.M. and S. Vanscoy 11 16 35 8	1675	(511)	3706	(1130)	3381	(1031)	108	(32.9)
13-16-35-8W3	C.M. and S. Vanscoy 13 16 35 8	1663	(507)	3655	(1114)	3355	(1023)	110	(33.5)
4-18-35-8W3	C.M. and S. Vanscoy 4 18 35 8	1663	(507)	3732	(1138)	3418	(1042)	112	(34.1)
4-20-35-8W3	C.M. and S. Vanscoy 4 20 35 8	1658	(505)	3661	(1116)	3375	(1029)	109	(33.2)
3-21-35-8W3	Cominco Vanscoy SWD	1662	(507)	5726	(1745)	3362	(1025)	108	(32.9)
4-22-35-8W3	C.M. and S. Vanscoy 4 22 35 8	1660	(506)	3731	(1137)	3380	(1030)	111	(33.8)
13-23-35-8W3	C.M. and S. Vanscoy 13 23 35 8	1663	(507)	3554	(1083)	3295	(1004)	107	(32.6)
4-24-35-8W3	C.M. and S. Vanscoy 4 24 35 8	1688	(514)	3710	(1131)	3369	(1027)	109	(33.2)
4-28-35-8W3	C.M. and S. Vanscoy 4 28 35 8	1652	(504)	3576	(1090)	3273	(998)	111	(33.8)
14-29-35-8W3	C.M. and S. Vanscoy 14 29 35 8	1671	(509)	3581	(1091)	3290	(1003)	107	(32.6)
4-30-35-8W3	C.M. and S. Vanscoy 4 30 35 8	1671	(509)	3716	(1133)	3435	(1047)	107	(32.6)
4-34-35-8W3	C.M. and S. Vanscoy 4 34 35 8	1645	(501)	3573	(1089)	3287	(1002)	109	(33.2)
13-22-36-8W3	Freeport Sulphur Grandora No. 13 22	1656	(505)	3495	(1065)	3194	(974)	113	(34.4)
13-1-37-8W3	Christie et al Dunfermline 13 1 37 8	1664	(507)	3482	(1061)	3167	(965)	121	(36.9)

Hubbard Mbr. Thickness		Neely Mbr. Top		Burr Mbr. Top		Second Red Bed Mbr. Top		Prairie Evaporite Top		Patience Lake Mbr. Top		Dawson Bay Cored Intervals	
ft	m	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m
		3620	(1103)	3672	(1119)	3732	(1138)	3742	(1141)	3782	(1153)	3680-3742	(1122-1141)
		3636	(1108)	3688	(1124)	3744	(1141)	3757	(1145)	3796	(1157)	3710-3757	(1131-1145)
		3574	(1089)	3643	(1110)	3695	(1126)	3706	(1130)	3741	(1140)	3598-3706	(1097-1130)
		3528	(1075)	3586	(1093)	3638	(1109)	3648	(1112)	3678	(1121)		
		3568	(1088)	3631	(1107)	3684	(1123)	3696	(1127)	3735	(1138)	3681-3696	(1122-1127)
		3493	(1065)	3547	(1081)	3607	(1099)	3618	(1103)	3647	(1112)		
		3153	(961)	3200	(975)	3250	(991)	3262	(994)	3262	(994)		
		2923	(891)	2971	(906)	3018	(920)	3034	(925)	3036	(925)	3030-3034	(924-925)
		2818	(859)	2867	(874)	2920	(890)	2938	(896)	Absent			
		3642	(1110)	3697	(1127)	3749	(1143)	3760	(1146)	3805	(1160)	3757-3760	(1145-1146)
		3272	(997)	3317	(1011)	3372	(1028)	3385	(1032)	Absent		3272-3385	(997-1032)
		3198	(975)	3244	(989)	3299	(1006)	3312	(1010)	3348	(1021)	3305-3311	(1007-1009)
		3230	(985)	3292	(1003)	3330	(1015)	3342	(1019)	3368	(1027)	3319-3342	(1012-1019)
		3165	(964)	3212	(979)	3262	(994)	3274	(968)	3314	(1010)	3170-3272	(966-997)
		3180	(969)	3232	(985)	3282	(1000)	3296	(1005)	3328	(1014)	3190-3220	(972-981)
		3197	(974)	3244	(989)	3295	(1004)	3309	(1009)	3355	(1023)	3203-3309	(976-1009)
		3134	(955)	3182	(970)	3232	(985)	3246	(989)	3268	(996)	3216-3246	(980-989)
		3135	(956)	3184	(971)	3236	(986)	3248	(990)	3268	(996)	3246-3248	(989-990)
		3178	(969)	3230	(985)	3285	(1001)	3296	(1005)	3302	(1006)	3188-3293	(972-1004)
		3182	(970)	3237	(987)	3287	(1002)	3302	(1006)	3305	(1007)		
		3815	(1163)	3865	(1178)	3917	(1194)	3930	(1198)	3972	(1210)		
		3644	(1111)	3690	(1125)	3757	(1145)	3768	(1148)	3783	(1153)		
		3515	(1071)	3578	(1091)	3626	(1105)	3637	(1109)	3667	(1118)		
		3280	(1000)	3334	(1016)	3383	(1031)	3395	(1035)	3434	(1047)	3380-3395	(1030-1035)
		3288	(1002)	3338	(1017)	3393	(1034)	3406	(1038)	3444	(1050)	3400-3406	(1036-1038)
		3204	(977)	3250	(991)	3292	(1003)	3314	(1010)	3358	(1024)		
		3264	(995)	3321	(1012)	3372	(1028)	3384	(1031)	3414	(1041)	3370-3384	(1027-1031)
		3242	(988)	3292	(1003)	3340	(1018)	3354	(1022)	?		3250-3354	(991-1022)
		3123	(952)	3172	(967)	3222	(982)	3235	(986)	3256	(992)	3220-3235	(981-986)
		3108	(947)	3160	(963)	3211	(979)	3224	(983)	3243	(988)	3112-3224	(949-983)
		3068	(935)	3115	(949)	3170	(966)	3184	(970)	?		3090-3184	(942-970)
		3038	(926)	3088	(941)	3140	(957)	3152	(961)	3163	(964)	3140-3152	(957-961)
		2960	(902)	3003	(915)	3061	(933)	3075	(937)	3080	(939)	3061-3075	(933-937)
		2925	(892)	2972	(906)	3030	(924)	3044	(928)	3047	(929)	3038-3044	(926-928)
		2891	(881)	2940	(896)	2994	(913)	3009	(917)	3020	(920)	3000-3009	(914-917)
		2795	(852)	2843	(867)	2892	(881)	2906	(886)	2906	(886)		
		3740	(1140)	3790	(1155)	3837	(1170)	3848	(1173)	3903	(1190)		
		3666	(1117)	3718	(1133)	3768	(1148)	3779	(1152)	3852	(1174)	3667-3723	(1118-1135)
		3638	(1109)	3700	(1128)	3754	(1144)	3767	(1148)	3797	(1157)		
		3569	(1088)	3624	(1104)	3673	(1120)	3684	(1123)	3728	(1136)		
		3500	(1067)	3543	(1080)	3596	(1096)	3609	(1100)	3642	(1110)	3603-3609	(1098-1100)
		3511	(1070)	3565	(1087)	3601	(1098)	3615	(1102)	3668	(1118)	3613-3615	(1101-1102)
		3447	(1051)	3488	(1063)	3543	(1080)	3556	(1084)	3590	(1094)	3548-3556	(1081-1084)
		3420	(1042)	3462	(1055)	3518	(1072)	3531	(1076)	3576	(1090)	3528-3531	(1075-1076)
		3388	(1033)	3427	(1045)	3482	(1061)	3495	(1065)	3539	(1079)	3393-3495	(1034-1065)
		3385	(1032)	3427	(1045)	3484	(1062)	3496	(1066)	3510	(1070)	3502-3496	(1067-1065)
		3356	(1023)	3397	(1035)	3452	(1052)	3464	(1058)	3489	(1063)		
		3381	(1031)	3422	(1043)	3477	(1060)	3489	(1063)	3520	(1073)	3381-3488	(1031-1063)
		3355	(1023)	3397	(1035)	3452	(1052)	3465	(1056)	3510	(1070)	3463-3465	(1056-1056)
		3418	(1042)	3462	(1055)	3517	(1072)	3530	(1076)	3579	(1091)	3424-3530	(1044-1076)
		3375	(1029)	3416	(1041)	3471	(1058)	3484	(1062)	3520	(1073)		
		3362	(1025)	3407	(1038)	3457	(1054)	3470	(1058)	3506	(1069)		
		3380	(1030)	3423	(1043)	3477	(1060)	3491	(1064)	3547	(1081)	3397-3476	(1035-1059)
												3481-3491	(1061-1064)
		3295	(1004)	3335	(1017)	3390	(1033)	3402	(1037)	3437	(1048)	3394-3402	(1034-1037)
		3369	(1027)	3411	(1040)	3465	(1056)	3478	(1060)	3551	(1082)	3476-3478	(1059-1060)
		3273	(998)	3318	(1011)	3371	(1027)	3384	(1031)	3422	(1043)	3376-3384	(1029-1031)
		3290	(1003)	3329	(1015)	3384	(1031)	3397	(1035)	3420	(1042)	3393-3397	(1034-1035)
		3435	(1047)	3477	(1060)	3528	(1075)	3542	(1080)	Absent			
		3287	(1002)	3330	(1015)	3382	(1031)	3396	(1035)	3434	(1047)	3390-3396	(1033-1035)
		3194	(974)	3242	(988)	3295	(1004)	3307	(1008)	3332	(1016)		
		3167	(965)	3216	(980)	3273	(998)	3288	(1002)	3302	(1006)		

Location	Well Name	K.B.		T.D.		Dawson Bay Top		Dawson Bay Thickness	
		ft	m	ft	m	ft	m	ft	m
16-6-37-8W3	National Potash Co Asquith No. 16 6	1640	(500)	3470	(1058)	3200	(975)	111	(33.8)
16-20-37-8W3	Pheas Banff Dunfermline 16 20 37 8	1644	(501)	3940	(1201)	3130	(954)	110	(33.5)
13-22-37-8W3	Freeport Dumfermline 13 22 37 8	1650	(503)	3370	(1027)	3058	(932)	110	(33.5)
13-1-38-8W3	Banff et al Asquith 13 1 38 8	1670	(509)	3933	(1199)	3037	(926)	114	(34.7)
13-28-38-8W3	Can Ex Langham 13 28 38 8	1637	(499)	3205	(977)	2962	(892)	116	(35.4)
1-2-39-8W3	Cdn. Expl. Langham A1 2 39 8	1662	(507)	4201	(1280)	2931	(893)	111	(33.8)
16-16-39-8W3	Can Ex Langham 16 16 39 8	1635	(498)	3123	(952)	2853	(870)	106	(32.3)
13-12-40-8W3	Sohio #3 Stratigraphic Test	1698	(517)	3166	(965)	2850	(869)	110	(33.5)
4-11-35-9W3	C.M. and S. Eagle 4 11 35 9	1762	(537)	3897	(1188)	3586	(1093)	109	(33.2)
4-12-35-9W3	C.M. and S. Eagle 4 12 35 9	1733	(528)	3833	(1168)	3544	(1080)	111	(33.8)
16-22-35-9W3	C.M. and S. Eagle 16 22 35 9	1780	(542)	3788	(1155)	3501	(1067)	108	(32.9)
4-24-35-9W3	C.M. and S. Eagle 4 24 35 9	1728	(527)	3731	(1137)	3437	(1048)	110	(33.5)
4-36-35-9W3	C.M. and S. Eagle 4 36 35 9	1754	(535)	3710	(1131)	3412	(1040)	108	(32.9)
4-16-36-9W3	Freeport Sulphur Asquith 4 16	1763	(537)	3455	(1053)	3341	(1018)	114	(34.7)
10-29-36-9W3	Pheas Banff et al Asquith 10 29 36 9	1729	(527)	4145	(1263)	3342	(1019)	114	(34.7)
13-14-37-9W3	National Potash Asquith 13 14 37 9	1658	(505)	3401	(1037)	3108	(947)	121	(36.9)
9-32-29-10W3	Gulf Tide Water Hughes No. 9	1888	(575)	4112	(1253)	4049	(1234)	?	
1-4-37-10W3	C.M. and S. Asquith 1 4 37 10	1762	(537)	3784	(1153)	3618	(1103)	120	(36.6)
7-32-39-10W3	Triad BPX Radisson 7 32 39 10	1705	(520)	3840	(1170)	3202	(976)	112	(34.1)
7-4-38-11W3	Continental Potash Arelee 7 4 38 11	1806	(550)	3495	(1065)	3415	(1041)	?	
4-2-41-11W3	Pheas Triad BD Fielding 4 2 41 11	1755	(535)	3747	(1142)	2860	(872)	105	(32.0)
15-21-31-12W3	Gulf Tidewater Brisbin No. 15 21	1938	(591)	4055	(1236)	4015	(1224)	?	
2-4-35-12W3	Pheas Arco Feudal 2 4 35 12	1861	(567)	4470	(1362)	3662	(1116)	112	(34.1)
16-11-35-12W3	Gulf Tidewater Hansen No. 16	1844	(562)	4130	(1259)	3628	(1106)	114	(34.7)
13-11-42-12W3	Continental Maymont 13 11 42 12	1826	(557)	4114	(1254)	2857	(871)	105	(32.0)
12-27-33-13W3	Gulf Tidewater Bents No. 12 27	1979	(603)	4385	(1337)	3876	(1181)	102	(31.1)
4-16-37-13W3	Pheas Chevron N Biggar 4 16 37 13	2210	(673)	4605	(1404)	3890	(1186)	105	(32.0)
3-4-39-13W3	Ceepee Riley Lake 3 4	2385	(727)	6270	(1911)	3800	(1158)	102	(31.1)
4-20-39-13W3	Chevron N. Biggar Prov. 4 20 39 13	2388	(728)	4600	(1402)	3712	(1131)	110	(33.5)
8-14-29-14W3	Texaco Fortune A8 14	1976	(602)	5082	(1549)	4380	(1335)	103	(31.4)
13-20-30-14W3	Imperial Fortune 13 20 30 14	1946	(593)	6480	(1975)	4572	(1394)	117	(35.7)
8-3-40-14W3	Ceepee Keppel Forest 8 3	2432	(741)	6047	(1843)	3746	(1142)	111	(33.8)

Hubbard Mbr. Thickness		Neely Mbr. Top		Burr Mbr. Top		Second Red Bed Mbr. Top		Prairie Evaporite Top		Patience Lake Mbr. Top		Dawson Bay Cored Intervals	
ft	m	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m
		3200	(975)	3245	(989)	3300	(1006)	3311	(1009)	3348	(1020)	3310-3311	(1009-1009)
		3130	(954)	3173	(967)	3228	(984)	3240	(988)	3275	(998)		
		3058	(932)	3105	(946)	3156	(962)	3168	(966)	3176	(968)	3162-3168	(964-966)
		3037	(926)	3092	(942)	3139	(957)	3151	(960)	3195	(974)		
		2926	(892)	2970	(905)	3029	(923)	3042	(927)	3061	(933)	2929-3042	(893-927)
		2931	(893)	2984	(910)	3030	(924)	3042	(927)	3051	(930)	2931-3042	(893-927)
		2853	(870)	2900	(884)	2949	(899)	2959	(902)	2963	(903)	2919-2959	(890-902)
		2850	(869)	2900	(884)E	2949	(899)E	2960	(902)E	?			
		3586	(1093)	3638	(1109)	3682	(1122)	3695	(1126)	3721	(1134)	3680-3695	(1122-1126)
		3544	(1080)	3599	(1097)	3642	(1110)	3655	(1114)	3697	(1127)	3649-3655	(1112-1114)
		3501	(1067)	3543	(1080)	3594	(1095)	3609	(1100)	3638	(1109)	3601-3609	(1098-1100)
		3437	(1048)	3490	(1064)	3533	(1077)	3547	(1081)	3580	(1091)	3542-3547	(1080-1081)
		3412	(1040)	3455	(1053)	3506	(1069)	3520	(1073)	3536	(1078)	3516-3520	(1072-1073)
		3341	(1018)	3388	(1033)	3442	(1049)	3455	(1053)	—	—		
		3342	(1019)	3382	(1031)	3442	(1049)	3456	(1053)	3506	(1069)		
		3108	(947)	3168	(966)	3218	(981)	3229	(984)	3241	(988)	3210-3229	(978-984)
		4049	(1234)	—	—	—	—	—	—	—	—		
		3618	(1103)	3672	(1119)	3727	(1136)	3738	(1139)	Absent		3718-3738	(1133-1139)
		3202	(976)	3250	(991)	3292	(1003)	3314	(1010)	Absent			
		3415	(1041)	—	—	—	—	—	—	—	—	3415-3495	(1041-1065)
		2860	(872)	2904	(885)	2950	(899)	2965	(904)	2969	(905)		
		4015	(1224)	—	—	—	—	—	—	—	—		
		3662	(1116)	3705	(1129)	3762	(1146)	3774	(1150)	3810	(1161)		
		3628	(1106)	3672	(1119)	3728	(1136)	3742	(1141)	3762	(1146)		
		2857	(871)	2896	(883)	2940	(896)	2963	(903)	Absent			
		3876	(1181)	3910	(1192)	3964	(1208)	3978	(1212)	3978	(1212)		
		3890	(1186)	3933	(1199)	3982	(1214)	3995	(1218)	4023	(1226)		
		3800	(1158)	3844	(1172)	3887	(1185)	3902	(1189)	3954	(1205)	3804-3834	(1159-1169)
												3882-3894	(1183-1187)
		3712	(1131)	3758	(1145)	3806	(1160)	3822	(1165)	3857	(1176)		
		4380	(1335)	4427	(1349)	4469	(1362)	4483	(1366)	4509	(1374)		
		4572	(1394)	?		?		4689	(1429)	Absent		4643-4689	(1415-1429)
		3746	(1142)	3792	(1156)	3844	(1172)	3857	(1176)	3890	(1186)	3774-3799	(1150-1158)

APPENDIX II

SELECTED CORE DESCRIPTIONS

Well Name	Lsd.	Member Cored			
		2nd Red Bed	Burr	Neely	Hubbard
KR et al Nokomis	8-7-30-20W2	X	X	X	X
Kerr McGee Esk	8-20-33-20W2	X	X	X	X
Marysburg No. 1	16-29-38-22W2	X		X	
SWP Boulder Lake	5-15-30-23W2	X	X	X	X
Alwinsal Dellwood 3 10	3-10-34-23W2			X	X
Dominion Potash Burr No. 4 18	4-18-35-23W2	X	X	X	
Alwinsal Iroquois 10 21	10-21-32-25W2	X	X	X	X
Duval Potash Co. Viscount	5-18-34-25W2	X	X	X	
Noranda Neely	16-21-34-27W2	X	X	X	
Kennco Prudhomme	3-27-38-27W2	X	X	X	
Kerr McGee Horseshoe	16-36-30-28W2	X	X		
Kennco 3 Prudhomme	12-10-38-28W2	X	X		
Kennco 2-Young	15-36-32-29W2	X	X	X	
Duval Aberdeen	3-30-37-2W3	X	X		
General Petroleums Saskatoon	6-12-38-4W3	X	X		
Goldfield Grt Cdn. Dundurn	10-7-32-5W3	X	X	X	
Duval Saskatoon	6-18-36-6W3	X	X	X	
Tide Water Swanson Crown No. 2	16-9-32-8W3		X	X	
W. James Donovan	16-34-33-8W3	X	X		
Cdn. Expl. Langham	1-2-39-8W3	X	X	X	
Continental Potash Arelee	7-4-38-11W3		X	X	
Ceepee Riley Lake	3-4-39-13W3			X	
Imperial Fortune	13-20-30-14W3	X			
Ceepee Keppel Forest 8 3	8-3-40-14W3		X	X	

KR et al Nokomis 8 7 30 20
Lsd. 8-7-30-20W2
K.B. 1751 ft (534 m)

Dawson Bay Fm: 3267-3419 ft (996-1042 m)
Cored Interval: 3278-3419 ft (999-1042 m)

Depth in feet (metres)	
	Overlying beds: halite of the Hubbard Evaporite.
	HUBBARD EVAPORITE
3278-3283 (999.1-1000.7)	Halite, transparent, crystals up to several cm diameter. Some veneers of buff insoluble residues. Plate 17(2).
	NEELY MEMBER
3283-3286 (1000.7-1001.6)	Anhydrite, blue-grey, dense, interbedded with transparent to translucent halite.
3286-3289 (1001.6-1002.5)	Anhydrite, blue-grey, dense, interbedded with buff cryptocrystalline dolomite.
3289-3293 (1002.5-1003.7)	Limestone, dolomitic, microcrystalline, buff to dark brown. ?algal laminae. Traces of anhydrite; some translucent and some black bituminous halite.
3293-3293.5 (1003.7-1003.9)	Anhydrite, blue-grey, dense, with buff cryptocrystalline dolomite.
3293.5-3298.5 (1003.9-1005.4)	Limestone, microcrystalline to finely sucrosic, buff. Well laminated in upper part; very bituminous in lower part. Gastropods. Halite plugged.
3298.5-3323 (1005.4-1012.9)	Limestone, microcrystalline, drab medium-brown. Argillaceous in part. Corals, crinoids, large stromatoporoids. Vugs, fractures and porosity plugged with halite. Minor hardground at the base.
3323-3333 (1012.9-1015.9)	Limestone, microcrystalline, drab medium-brown, argillaceous. Few crinoid ossicles. Two minor hardgrounds and a well-defined hardground at the base.

BURR MEMBER

3333-3357 (1015.9-1023.2)	Limestone, microcrystalline, medium brown. Numerous hardgrounds, beneath which the limestone is cryptocrystalline and greyish for a few cm. Corals and crinoid ossicles common. Occasional clusters of translucent brown anhydrite needles.
3357-3384 (1023.2-1031.4)	Limestone, similar to above, except drab olive-brown, mottled, bioturbated and rare fossils. Three hardgrounds in lower part.
3384-3404 (1031.4-1037.5)	Dolomite, microcrystalline, drab olive-brown; featureless except for bioturbation. Unfossiliferous.

SECOND RED BED MEMBER

3404-3409 (1037.5-1039.1)	Mudstone, dolomitic, grey, well-laminated and lithified in upper part with depositional dip of 15-20°.
3409-3414 (1039.1-1040.6)	Mudstone, dolomitic, brown, disaggregated. Orange halite in cracks.
3414-3419 (1040.6-1042.1)	Mudstone, dolomitic, reddish-brown with occasional green mottles. Poorly consolidated except lower third which is intimately mixed with halite and contains thin (3mm) crust-like laminae of anhydrite. Contact with underlying Prairie Evaporite is undulating [Plate 2(4)].

PRAIRIE EVAPORITE

3419 (1042.1)	White to pink translucent halite.

Kerr McGee Esk 8 20 33 20
Lsd. 8-20-33-20W2
K.B. 1805 ft (550 m)

Dawson Bay Fm: 2940-3106 ft (896-947 m)
Cored Interval: 2965-3106 ft (904-947 m)

Depth in feet
(metres)

Overlying beds: halite of the Hubbard Evaporite.

TRANSITIONAL SEQUENCE BETWEEN HUBBARD EVAPORITE AND UNDERLYING NEELY MEMBER

2965-2980 (903.7-908.3)	Mudstone, dolomitic, red, interbedded and intermixed with translucent halite. Halite dominant in some parts of the sequence. Mudstone greenish in places, and some bands of dense bluish-grey anhydrite. Mixture of lithologies probably represents marginal facies of the Hubbard Evaporite, or insoluble residue from partial solutioning of the salts.
2980-2987.5 (908.3-910.6)	Anhydrite, dark bluish-grey and dense, interbedded with halite, and buff cryptocrystalline dolomite [Plate 16(1)]. Fractures in the dolomite are plugged with halite.
2987.5-2988.2 (910.6-910.8)	Dolomite, cryptocrystalline, pale brown with grey mottles. Irregular patches of anhydrite. Fine laminations.
2988.2-2992.5 (910.8-912.1)	Limestone, microcrystalline, medium brown, bituminous [Plate 10(5)]. Biosparite in part [Plate 12(4)]. Stromatoporoids, gastropods; incipient stylolites; small vugs plugged with halite. Some gastropod shells replaced by halite [Plate 18(2)].
2992.5-2994 (912.1-912.6)	Anhydrite, grey translucent, interbedded with medium brown, laminated, microcrystalline dolomite.
2994-2997 (912.6-913.5)	Limestone, microcrystalline, medium brown and laminated at top, grading down into black bituminous limestone with gastropods. Vugs infilled with halite.
2997-3016 (913.5-919.3)	Limestone, microcrystalline to finely sucrosic, drab medium to dark brown. Black bituminous wavy layers. Solitary corals and large stromatoporoids. Relatively argillaceous band from 3009-3011 ft (917.1-917.8 m) with very few fossils. Porosity plugged with halite.
3016-3026 (919.3-922.3)	Limestone, argillaceous, drab grey olive-brown, microcrystalline to sucrosic [Plate 11(5)]. Few fossils. Fractures and vugs plugged with halite. Minor hardground at 3021 ft (920.8 m). Well defined hardground at the base.

	BURR MEMBER
3026-3074 (922.3-937.0)	Limestone, microcrystalline, drab medium brown, except cryptocrystalline and grey for several cm beneath each of the numerous hardgrounds. Fossils are brachiopods, corals, bryozoans and crinoid ossicles. The cryptocrystalline limestone has near vertical fractures. Porosity and fratures plugged with halite.
3074-3088 (937.0-941.2)	Limestone, microcrystalline, mainly grey, mottled. Sparse crinoid ossicles.
3088-3092 (941.2-942.4)	Dolomite, microcrystalline, greyish-brown, mottled and bioturbated. Breccia of sucrosic dolomite at the base with porosity plugged by halite.
	SECOND RED BED MEMBER
3092-3096 (942.4-943.7)	Mudstone, dolomitic, grey, laminated and lithified upper part.
3096-3106 (943.7-946.7)	Mudstone, dolomitic, brown grading down to red. Poorly consolidated. Green mudstone with veins of orange halite above the basal contact.
	PRAIRIE EVAPORITE
3106 (946.7)	Red halite.

Marysburg No. 1
Lsd. 16-29-38-22W2
K.B. 1825 ft (556 m)

Dawson Bay Fm: 2654-2779 ft (809-847 m)
Cored Interval: 2665-2696 ft (812-822 m) and 2772-2779 ft (845-847 m)

Depth in feet (metres)	
	Overlying beds: anhydrite at top of Neely Member.
	NEELY MEMBER
2665-2666 (808.9-812.6)	Thin bed of buff dolomite overlying white mosaic of fibrous anhydrite.
2666-2688 (812.6-819.3)	Dolomite, calcareous, sucrosic, drab olive-brown. Patches of pale yellow-brown limestone. Stromatoporoids and corals, with few brachiopods (*Stringocephalus*) and crinoid ossicles. Anhydrite fills some near vertical fractures, and occurs as scattered blebs, needles and felty nodules, and replaces the centres of some stromatoporoids. Fair porosity and permeability.
2688-2696 (819.3-821.7)	Dolomite, calcareous, argillaceous, grey, with brown to reddish streaks in lowermost part. Corals, crinoids and a few brachiopods. One vertebrate tooth.
Bottom of cored section	
	SECOND RED BED MEMBER
2772-2779 (844.9-847.0)	Mudstone, dolomitic, grey with occasional green bands. Friable. Metallic pink lustre to residues after carnallite.
	PRAIRIE EVAPORITE
2779 (847.0)	Halite and sylvite with carnallitic residues.

S W P Boulder Lake 5 15 30 23
Lsd. 5-15-30-23W2
K.B. 1669 ft (509 m)

Dawson Bay Fm: 3316-3455 ft (1011-1053 m).
Cored Interval: Entire formation.

	Overlying beds: Green and red dolomitic mudstones of the First Red Bed (Souris River Fm.).
	HUBBARD EVAPORITE
3316-3324 (1010.7-1013.2)	Halite, transparent, large crystals (several cm in dia.). Few streaked bands and pockets of green dolomitic mudstone. Lower part has greater abundance of red and green irregularly shaped clasts of dolomitic mudstone.

NEELY MEMBER

3324-3333 (1013.2-1015.9)	Anhydrite, dark bluish-grey and dense, interbedded with greenish-grey dolomitic mudstone. Several bands of fibrous orange halite up to 5 cm thick [Plate 17(1)].
3333-3336 (1015.9-1016.9)	Anhydrite, bluish-grey and dense, interbedded with buff dolomite most of which is algal [Plate 14(3)]. Traces of halite.
3336-3338 (1016.9-1017.4)	Limestone, microcrystalline, buff with brachiopods, gastropods, corals and stromatoporoids. Vugs are plugged with bituminous halite.
3338-3338.5 (1017.4-1017.6)	Limestone, finely sucrosic, buff, laminated, and devoid of fossils.
3338.5-3340 (1017.6-1018.0)	Anhydrite, bluish-grey and dense, intermixed with buff cryptocrystalline dolomite.
3340-3342 (1018.0-1018.6)	Limestone, dolomitic, microcrystalline, buff. Well laminated. Pores filled with halite. Plate 12(1) shows the carbonate to be composed of pellets.
3342-3345 (1018.6-1019.6)	Limestone, microcrystalline, medium to dark grey, bituminous. Black bituminous halite in lower part. Gastropods and brachiopods.
3345-3368 (1019.6-1026.6)	Limestone, microcrystalline, drab medium brown. Large stromatoporoids. Brachiopods and corals (?*Bethanophyllum*). Blebs (< ½ cm) of bluish-grey anhydrite scattered throughout. Vugs and pores plugged with halite. Moderately argillaceous band from 3364-3366 ft (1025.3-1026 m) with no fossils.
3368-3376 (1026.6-1029.0)	Limestone, microcrystalline to cryptocrystalline, slightly argillaceous, drab greenish-brown. Crinoids, corals, but no stromatoporoids. Minor hardgrounds at 3370 ft (1027.2 m) and at the base. Vugs and fractures plugged with halite.

BURR MEMBER

3376-3425 (1029.0-1043.9)	Limestone, microcrystalline, drab medium to pale brown. Eight well-defined hardgrounds [cf. Plates 6(3) and 6(4)] and six minor hardgrounds [cf. Plate 7(4)]. Lithology is grey beneath hardgrounds. SEM photographs of lithologies above and below the hardground at 3390 ft (1033.3 m) demonstrate changes in porosity at these surfaces. Fossils include crinoids, brachiopods, corals, bryozoans and calcispheres. Small rosettes of brownish translucent anhydrite needles at 3400 ft (1047 m).
3425-3440 (1043.9-1048.5)	Dolomite, drab olive-green, microcrystalline. Calcareous in upper part. No fossils, but extensively bioturbated. Porosity is plugged with halite.

SECOND RED BED MEMBER

3440-3455 (1048.5-1053.1)	Mudstone, dolomitic, grey in upper half, red in lower half. Poor recovery (about 50 percent). Greenish-grey dolomitic mudstone at base. Mixture of red halite and mudstone at the junction with the underlying Prairie Evaporite. Poorly consolidated sediments.

PRAIRIE EVAPORITE

3455 (1053.1)	Red halite.

Alwinsal Dellwood 3 10
Lsd. 3-10-34-23W2
K.B. 1786 ft (544 m)

Dawson Bay Fm: 3039-3177 ft (926-968 m)
Cored Interval: Entire formation (only upper part described in order to demonstrate the variability in lithologies near the Hubbard/Neely junction).

Depth in feet (metres)

Overlying beds: red and green dolomitic mudstones of the First Red Bed of the Souris River Fm.

HUBBARD EVAPORITE

3039-3039.5 (926.3-926.4)	Transitional zone between halite of the Hubbard Evaporite and the overlying dolomitic mudstones.

3039.5-3041 (926.4-926.9)	Halite, transparent and coarsely crystalline, free from impurities.
3041-3046 (926.9-928.4)	Halite mosaic, interbedded and mixed with pale dolomitic mudstone.
	NEELY MEMBER
3046-3052 (928.4-930.2)	Mudstone, dolomitic, medium-grey; laminae of dark grey anhydrite; orange halite fills fractures. (This bed is probably the residue of insoluble material from a once-thicker Hubbard Evaporite.)
3052-3055 (930.2-931.2)	Dolomite and microcrystalline limestone (buff), intermixed with abundant clear halite. Pellets and gastropods.
3055-3055.5 (931.2-931.3)	Anhydrite, dark grey, dense.
3055.5-3058 (931.3-932.1)	Limestone, microcrystalline, medium brown, bituminous.
3058-3061 (932.1-933.0)	Limestone, microcrystalline, dark brown, bituminous. Small gastropods, sometimes infilled with halite.
	Underlying beds: Microcrystalline limestone of the Burr Member, containing large stromatoporoids and stringocephalid brachiopods.

Dominion Potash Burr No. 4 18
Lsd. 4-18-35-23W2
K.B. 1844 ft (562 m)

Dawson Bay Fm: 3027-3149 ft (923-960 m)
Cored Interval: Entire formation.

Depths in feet
(metres)

	Overlying beds: greenish dolomitic mudstone with reddish-white veins of anhydrite, comprising the First Red Bed (Souris River Fm.).
	NEELY MEMBER
3027-3029 (922.6-923.2)	Anhydrite, blue-grey, dense, interbedded with dolomitic mudstone at the top, and buff cryptocrystalline dolomite in the lower part.
3029-3029.5 (923.2-923.4)	Limestone, sucrosic, buff, laminated.
3029.5-3030.5 (923.4-923.7)	Limestone, dolomitic, microcrystalline, black and bituminous. Stromatoporoids, and halite-filled gastropods and vugs.
3030.5-3031.2 (923.7-923.9)	Limestone, fragmental, buff, laminated. Brownish-red pseudomorphs after pyrite. Fair porosity.
3031.2-3035.5 (923.9-925.2)	Anhydrite, bluish, dense, intermingled with buff cryptocrystalline dolomite.
3035.5-3036.5 (925.2-926.2)	Limestone, microcrystalline, buff. Finely laminated.
3036.5-3037.5 (926.2-927.2)	Limestone, microcrystalline, buff; irregular laminae. Black bituminous incipient stylolites. Annealed fracture (45°) with 5 mm displacement. Few vugs infilled with white anhydrite.
3037.5-3064 (927.2-933.9)	Limestone, microcrystalline, buff and brown, bituminous. Wispy laminae and some grey irregular bands. High faunal content of stromatoporoids, solitary corals, crinoid ossicles, and the large thin-shelled brachiopod *Stringocephalus* [Plates 10(3) and 13(1)].
3064-3072 (933.9-936.3)	Limestone, argillaceous, microcrystalline, greenish-grey. Corals, crinoid ossicles and brachiopods. Well-defined hardground at base.
	BURR MEMBER
3072-3122 (936.3-951.6)	Limestone, microcrystalline, medium grey to brown. Mottled by bioturbation. Corals, crinoid ossicles and brachiopods. Occasional needles of translucent brown anhydrite. Numerous hardgrounds, each of which are extensively burrowed, and usually exhibit a colour change of the sediment from grey beneath to pale brown above [Plate 6(2)].
3122-3126 (951.6-952.8)	Limestone, dolomitic, microcrystalline to microsucrosic, medium to dark grey; finely mottled due to extensive reworking by bioturbation. No macrofossils. Few blebs of whitish anhydrite.

3126-3135 (952.8-955.5)	Dolomite, sucrosic, drab olive-brown mottled. Porosity filled with halite. Analysis shows 62% carbonate, 32% halite and 6% insoluble residue. Lowermost few cm finely laminated.

SECOND RED BED MEMBER

3135-3143 (955.5-958.0)	Mudstone, dolomitic, grey; upper part lithified, remainder has blocky 'marl-type' fracture and is poorly consolidated.
3143-3149 (958.0-959.8)	Mudstone, dolomitic, red; blocky fracture. Green and red shale near base.

PRAIRIE EVAPORITE

3149 (959.8)	Red halite.

Alwinsal Iroquois 10 21
Lsd. 10-21-32-25W2
K.B. 1773 ft (540.4 m)

Dawson Bay Fm: 3318-3463 ft (1011-1056 m)
Cored Interval: Entire formation.

Depth in feet
(metres)

Overlying beds: dolomitic mudstone of the First Red Bed (Souris River Fm.).

HUBBARD EVAPORITE

3318-3340 (1011.3-1018.0)	Uppermost few feet show gradational contact of anhydritic green mudstone of the First Red Bed (Souris River Fm.) with halite of the Hubbard Evaporite. Remainder of unit is transparent halite (20% recovery) with thin laminae of buff dolomite and anhydrite.
3340-3343 (1018.0-1018.9)	Anhydrite, bluish-grey and dense, interbedded with reddish and grey dolomitic mudstone.
3343-3350 (1018.9-1021.1)	Interlaminated anhydrite, dolomitic mudstone and abundant halite. Twenty cm band of gastropods at 3347 ft (1020 m) impregnated with halite. Occasional thin bands of dolomite or dolomitic limestone.

NEELY MEMBER

3350-3355 (1021.1-1022.6)	Limestone capped by 3 cm of laminated dolomitic limestone. Limestone is microcrystalline, pelleted, and buff to nearly black where carbonaceous and bituminous content is high. Porosity is plugged by white anhydrite and halite. Abundant gastropods; *Amphipora* and stromatoporoids in lower part.
3355-3368 (1022.6-1026.6)	Limestone, finely sucrosic, drab medium-brown; partially dolomitized; dark wavy and wispy laminae. Stromatoporoids, brachiopods and corals abundant; upper part contains many large (up to 10 cm) thin shells of *Stringocephalus*.
3368-3377 (1026.6-1029.3)	Dolomite calcareous, finely sucrosic, buff. Similar features to above, but good porosity and permeability.
3377-3384 (1029.3-1031.4)	Dolomite, calcareous, microcrystalline, grey; low porosity and permeability. Few corals and crinoid ossicles, no stromatoporoids. Base marked by hardground.
3384-3396 (1031.4-1035.1)	Limestone, dolomitic, microcrystalline, argillaceous, mottled grey to drab olive; low porosity and permeability. Scattered crinoid ossicles. Dolomite and argillaceous content decrease with depth. Lower part is medium to pale brown and wavy laminated with wisps of darker brown material. Three minor hardgrounds and a well-defined hardground at the base.

BURR MEMBER

3396-3436 (1035.1-1047.3)	Limestone, microcrystalline, buff with grey mottles; indistinct wavy/wispy laminae. Seventeen hardgrounds, plus a well-defined hardground at the base. Crinoid ossicles scattered throughout; corals mainly just above hardgrounds; brachiopods (large strophomenids) are more abundant beneath 3425 ft (1044 m). Brown translucent needles of anhydrite at 3433 ft (1046 m).
3436-3442 (1047.3-1049.1)	Limestone, microcrystalline, grey grading down to buff. Scattered crinoid ossicles.

3442-3449 (1049.1-1051.3)	Limestone, dolomitic, microcrystalline drab olive-brown, argillaceous. Fossils only at the top; remainder extensively bioturbated.

SECOND RED BED MEMBER

3449-3453 (1051.3-1052.5)	No core, hence contact with Second Red Bed not seen.
3453-3463 (1052.5-1055.5)	Mudstone, dolomitic, grey, green and red — jumbled together in one box (30% recovery).

PRAIRIE EVAPORITE

3463 (1055.5)	Red halite.

Duval Potash Co. Viscount 5 18 34 25 Lsd. 5-18-34-25W2 K.B. 1857 ft (566 m)

Dawson Bay Fm: 3363-3486 ft (1025-1063 m)
Cored Interval: Entire formation.

The junction between the First Red Bed and the top of the Dawson Bay Formation (Neely Mbr.) is gradational.

Depth in feet
(metres)

NEELY MEMBER

3363-3372 (1025.0-1027.8)	Mudstone, dolomitic, green with reddish-brown bands, intermixed with lesser amounts of bluish-grey anhydrite.
3372-3375 (1027.8-1028.8)	Anhydrite, bluish-grey, interbedded with cryptocrystalline buff dolomite.
3375-3377 (1028.8-1029.3)	Dolomite, sucrosic, pale brown, high porosity and permeability. Upper part contains black carbonaceous material, and gastropods plugged with halite.
3377-3379 (1029.3-1029.9)	Anhydrite, bluish-grey, dense, interlaminated with buff cryptocrystalline dolomite.
3379-3381 (1029.9-1030.5)	Dolomite, sucrosic, pale brown, indistinct laminae. High porosity and permeability, although partially plugged with halite and anhydrite.
3381-3384 (1030.5-1031.5)	Limestone, microcrystalline, drab medium-brown. Abundant black bituminous partings. Gastropod moulds. Porosity partially plugged by whitish granular anhydrite.
3384-3400 (1031.5-1036.3)	Limestone, microcrystalline to finely sucrosic, medium brown. Diffuse bituminous wisps. Abundant fauna of stromatoporoids, corals, and stringocephalid brachiopods. Base of unit marked by a minor depositional break.
3400-3409 (1036.3-1039.1)	Limestone, microcrystalline, argillaceous, grey. Occasional thin wavy black laminae. Two minor hardgrounds and a well-defined hardground at the base. Fauna comprises corals, brachiopods, and crinoid ossicles.

BURR MEMBER

3409-3432 (1039.1-1046.1)	Limestone, microcrystalline to sucrosic, medium-brown, cryptocrystalline from 3423-3427 ft (1043-1045 m). Scattered subangular intraformational mudstone pebbles (less than 2 cm dia.). Crinoids and brachiopods scattered throughout. Three vestigial and six well-defined hardgrounds.
3432-3446 (1046.1-1050.3)	Limestone, microcrystalline, brown, argillaceous. Diffuse wavy laminae. Crinoid ossicles and brachiopods. Two vestigial hardgrounds. Core badly broken.
3446-3449 (1050.3-1051.3)	Limestone — practically a coquina of brachiopods and crinoid ossicles, with scattered intraformational mudstone pebbles. Three hardgrounds.
3449-3457 (1051.3-1053.7)	Limestone, microcrystalline, buff; crinoids, with occasional brachiopods and corals around 3452 ft (1052 m). Grey and relatively argillaceous in upper part. Six minor and two major hardgrounds.
3457-3469 (1053.7-1057.4)	Limestone, microcrystalline, argillaceous, grey. Unfossiliferous, but extensive dark mottling due to small burrows. Steep angle fracture infilled with white anhydrite. Part of core broken.

3469-3472 (1057.4-1058.3)	Dolomite, microsucrosic, argillaceous, drab greenish-grey, featureless. Basal few cm composed of brown microcrystalline limestone, finely laminated with bituminous material.

SECOND RED BED MEMBER

3472-3474 (1058.3-1058.9)	Mudstone, dolomitic, grey with tiny black to dark grey fragments. Lithified and faintly laminated.
3474-3481 (1058.9-1061.0)	Mudstone, dolomitic, grey, poorly consolidated. Lower part is reddish-brown.
3481-3486 (1061.0-1062.5)	Mudstone, dolomitic, red; brecciated with halite.

PRAIRIE EVAPORITE

3486 (1062.5)	Red halite.

Noranda Neely 16 21 34 27
Lsd. 16-21-34-27W2
K.B. 1806 ft (550 m)

Shaft Hole to Central Canada Potash Mine: Type Section for Neely Member and Second Red Bed Member.

Dawson Bay Fm: 3188-3314 ft (972-1010 m)
Cored Interval: Entire formation.

Depth in feet
(metres)

Overlying beds: green and red dolomitic mudstone with minor anhydrite, comprising the First Red Bed (Souris River Fm.).

NEELY MEMBER

3188-3192 (971.7-972.9)	Anhydrite, bluish-grey, dense, mixed with greenish dolomitic mudstone, and buff cryptocrystalline dolomite. Includes three 3 cm thick bands of dolomitic mudstone intimately mixed with orange halite.
3192-3194.5 (972.9-973.7)	Limestone, microcrystalline: upper half black and bituminous with halite-filled vugs and dwarf gastropods [Plate 18(3)]; lower half faintly laminated, buff, unfossiliferous, with small 'birds-eye' vugs plugged with halite.
3194.5-3196.5 (973.7-974.3)	Anhydrite, bluish-grey, dense, intermixed with buff cryptocrystalline dolomite.
3196.5-3197.3 (974.3-974.5)	Limestone, dolomitic, finely sucrosic, laminated. ? algal mats. Greenish dolomitic mudstone streaks in lower part.
3197.3-3200.6 (974.5-975.5)	Limestone, bituminous, microcrystalline, medium to dark brown. Halite-filled gastropods and vugs.
3200.6-3203.1 (975.5-976.3)	Limestone, sucrosic to microcrystalline, buff, laminated. Polymict breccia at the base contains anhydrite, carbonate fragments and a stromatoporoid. Probably a micro-karst feature [Plate 19(1)].
3203.1-3217 (976.3-980.5)	Limestone, slightly bituminous, microcrystalline to sucrosic, medium brown. Scattered small and large stromatoporoids and stringocephalid brachiopods [Plates 10(4) and 17(4)]; bryozoans and solitary corals. Bluish anhydrite blebs. Sequence plugged with halite.
3217-3226.3 (980.5-983.4)	Limestone, microcrystalline, dark-brown and bituminous. Abundant stromatoporoids, bryozoans and corals. Halite-filled vugs, bluish nodules of anhydrite.
3226.3-3240 (983.4-987.6)	Limestone, microcrystalline to cryptocrystalline, argillaceous, medium to pale olive-brown; poorly fossiliferous (scattered crinoid ossicles including *Gasterocoma* ; bryozoans, gastropods and corals). Lower part extensively bioturbated. Nodules of bluish anhydrite; halite-filled vugs. Three hardgrounds and a well-defined hardground showing an eroded crinoid ossicle [Plate 1(4)] at the base.

	BURR MEMBER
3240-3287 (987.6-1001.9)	Limestone, dolomitic; microcrystalline and buff above, to cryptocrystalline and grey beneath each of eighteen hardgrounds. Wavy-laminated to nodular with wispy bituminous bands. Scattered nodules of bluish anhydrite and needles of brown translucent anhydrite. Poorly fossiliferous, mainly crinoid ossicles (including *Gasterocoma*), fragmented brachiopods and a few corals. Some shells replaced by halite, some by anhydrite. Some pyritic outlines to fossils. Well-defined hardground at base.
3287-3300 (1001.9-1005.8)	Dolomite, slightly calcareous, microcrystalline to finely sucrosic, drab olive-brown. Unfossiliferous, but mottled by bioturbation. Few scattered nodules of bluish anhydrite. Basal 12 cm is a carbonate breccia cemented by halite, with bituminous veneers and anhydrite.
	SECOND RED BED MEMBER
3300-3306 (1005.8-1007.7)	Mudstone, dolomitic, greenish-grey to grey. Uppermost 5 cm composed of grey disturbed laminae with annealed microfaults and a microbreccia. Underlying sediments are shaly and less well-consolidated. Few small bluish translucent nodules of anhydrite. A vertical fracture filled with fibrous orange halite terminates in the laminated beds.
3306-3310 (1007.7-1008.9)	Mudstone, dolomitic, olive to olive-brown. Veins of orange halite. Poorly consolidated.
3310-3314 (1008.9-1010.1)	Mudstone, dolomitic, reddish-brown. Riddled with veins of orange halite. Very poorly consolidated. Local greenish bands. Transitional lower contact.
	PRAIRIE EVAPORITE
3314 (1010.1)	Red to pink halite with minor red dolomitic mudstone.

Kennco Prudhomme 3 27 38 27
Lsd. 3-27-38-27W2
K.B. 1994 ft (608 m)

Dawson Bay Fm: 3020-3143 ft (920-958 m)
Cored Interval: Entire formation.

Depth in feet (metres)	
	Overlying beds: green dolomitic mudstone interbedded with anhydrite, comprising the First Red Bed (Souris River Fm.).
	NEELY MEMBER
3020-3023 (920.5-921.5)	Anhydrite, bluish-grey, dense. Plates 12(2) and 15(2) show detail of the contact with the underlying dolomite.
3023-3027 (921.5-922.6)	Dolomite, sucrosic, buff, laminated, grading down into limestone, finely sucrosic, bituminous drab medium to dark brown. Flattened vugs lined with calcite. Minor anhydrite.
3027-3055 (922.6-931.2)	Limestone, dolomitic [Plate 11(1)], microcrystalline to sucrosic, moderately bituminous, medium to dark brown. Abundant stromatoporoids, with corals and crinoid ossicles in the lower part. Few nodules of bluish-white anhydrite up to 3 cm. Moderate porosity. Hardground at base.
3055-3062 (931.2-933.3)	Limestone, dolomitic, argillaceous, microcrystalline, grey. Bioturbated with few crinoid ossicles: no other fauna. Hardground at base.
	BURR MEMBER
3062-3086 (933.3-940.6)	Limestone, dolomitic, microcrystalline to finely sucrosic, drab pale brown. Six hardgrounds above which fauna [mainly corals and brachiopods, Plate 7(3)] and lithoclasts are concentrated. Halite in vugs.
3086-3094 (940.6-943.1)	Limestone, dolomitic, sucrosic, drab brown. Indistinctly laminated to featureless. Unfossiliferous.

3094-3114 (943.1-949.1)	Limestone, microcrystalline, buff, mottled. Moderately fossiliferous: corals, brachiopods and crinoid ossicles. Two hardgrounds, plus another at the base.
3114-3125 (949.1-952.5)	Dolomite, calcareous, finely sucrosic, drab medium brown to grey. Mottled by bioturbation. Scattered crinoid ossicles, except no fauna in lower part. Hardground at 3122 ft (952 m).
	SECOND RED BED MEMBER
3125-3130 (952.5-954.0)	Mudstone, dolomitic, grey, laminated and well consolidated in upper part [Plate 4(1)]. Enterolithic laminae of anhydrite, and bituminous laminae at the top. Minor erosional surfaces. Lower part not laminated and not well consolidated.
3130-3143 (954.0-958.0)	Mudstone, dolomitic, red, locally green. Upper part is drab olive-grey. Moderately well consolidated.
	PRAIRIE EVAPORITE
3143 (958.0)	Red halite with sylvite and carnallite.

Kerr-McGee Horseshoe
16 36 30 28
Lsd. 16-36-30-28W2
K.B. 1916 ft (584 m)

Dawson Bay Fm: 3690-3818 ft (1125-1164 m)
Cored Interval: 3758-3818 ft (1145-1164 m)

Depth in feet (metres)

Overlying beds: limestones of the upper Burr Member.

BURR MEMBER

3758-3786 (1145.4-1154.0)	Limestone, dolomitic, microcrystalline to finely sucrosic, drab pale brown. Mottled; grey argillaceous streaks and clasts. Crinoid ossicles, corals and brachiopods (including atrypids and strophomenids). Ten hardgrounds, plus a well-defined hardground at the base.
3786-3802 (1154.0-1158.8)	Dolomite, slightly calcareous, argillaceous, microsucrosic to sucrosic [Plate 6(1)], drab olive-grey. Bioturbated and unfossiliferous. Lowermost part is mottled and contains bluish anhydrite nodules, and vugs filled with halite.
	SECOND RED BED MEMBER
3802-3810 (1158.8-1161.3)	Mudstone, dolomitic, grey. Finely laminated and lithified over top few cm, and transected by microfaults. Underlying less well-consolidated strata exhibit slickensiding.
3810-3818 (1161.3-1163.7)	Mudstone, dolomitic, brown to red with green mottling. Moderately well consolidated.
	PRAIRIE EVAPORITE
3818 (1163.7)	Halite.

Kennco 3 Prudhomme
12 10 38 28
Lsd. 12-10-38-28W2
K.B. 1846 ft (563 m)

Dawson Bay Fm: 2950-3067 ft (899-935 m)
Cored Interval: 3032-3067 ft (924-935 m)

Depth in feet (metres)

Overlying beds: limestone of the upper Burr Member.

BURR MEMBER

3032-3044 (924.2-927.8)	Limestone, microcrystalline, pale brown and grey. Wavy-laminated to pseudo-nodular, except diffuse laminae in lower part. Brachiopods crinoid ossicles and corals in upper part; scattered crinoid ossicles in lower part. Five hardgrounds and a well-defined hardground at the base. Porosity plugged with halite.

3044-3053 (927.8-930.6)	Limestone, microcrystalline, slightly argillaceous, drab olive-brown: grades down into microsucrosic argillaceous dolomite. Bioturbated but no fauna. Small blue nodules of anhydrite. Lowermost 6 cm is microcrystalline limestone with wavy bituminous laminae, underlain by 2 mm lamina of oil-shale. Angular discordance (10°) with underlying strata.
	SECOND RED BED MEMBER
3053-3056.5 (930.6-931.6)	Mudstone, dolomitic, grey; laminated, eroded and slumped for top 10 cm [Plate 1(2)]. Microbreccia; streaks of pyrite; small blebs of anhydrite. Remainder of unit is less well-consolidated and featureless.
3056.5-3061 (931.6-933.0)	Mudstone, dolomitic, olive-brown and greenish. Lower half contains vertical veins of orange halite up to 2 cm across.
3061-3067 (933.0-934.8)	Mudstone, dolomitic, brown to red with few green bands in lower part. Acetate peel reveals microbrecciation. Basal part mixed with halite.
	PRAIRIE EVAPORITE
3067 (934.8)	Red halite with minor red and green dolomitic mudstone.

Kennco 2-Young 15 36 32 29
Lsd. 15-36-32-29W2
K.B. 1762 ft (537 m)

Dawson Bay Fm: 3490-3621 ft (1064-1104 m)
Cored Interval: Entire formation.

Depth in feet (metres)	
	Overlying beds: red and green dolomitic mudstones of the First Red Bed of the Souris River Fm.
	NEELY MEMBER
3490-3492.5 (1063.8-1064.5)	Anhydrite, bluish-grey, dense, interbedded with greenish-grey dolomitic mudstone. Veins of orange halite.
3492.5-3494.5 (1064.5-1065.1)	Dolomitized algal heads, buff, plugged with bituminous halite [Plate 18(1)].
3494.5-3500 (1065.1-1066.8)	Anhydrite, bluish, dense, interbedded with buff microcrystalline dolomite.
3500-3505 (1066.8-1068.3)	Dolomite, microcrystalline to sucrosic, dark brown; ? algal laminae. Plugged with bituminous halite.
3505-3528 (1068.3-1075.3)	Limestone, microcrystalline, medium brown to grey. Broad diffuse bands. Corals, gastropods and crinoid ossicles. Stromatoporoids beneath 3518 ft (1072 m). Porosity plugged with halite. One minor hardground, and another at the base.
3528-3534 (1075.3-1077.2)	Limestone, microcrystalline, buff to greyish, slightly argillaceous. Brachiopods, and crinoid ossicles. Halite in vugs. Major erosional surface (hardground) at base (Frontispiece).
	BURR MEMBER
3534-3562 (1077.2-1085.7)	Limestone, microcrystalline, buff to grey; mottled to diffusely banded. Eroded stromatoporoid at top of sequence, below which stromatoporoids are absent: fauna comprises brachiopods, corals and crinoid ossicles. Porosity is plugged with halite, and chevron halite present. Nine hardgrounds.
3562-3567 (1085.7-1087.2)	Dolomite, microsucrosic, drab olive-brown. Bioturbated, no fossils.
3567-3582 (1087.2-1091.8)	Limestone, dolomitic, cryptocrystalline to microcrystalline, drab brown. Unfossiliferous. Fractures up to 2 cm wide are vertical to 30° from vertical, and infilled with halite or occasionally anhydrite. Hardground at 3570 ft (1088 m) and at the base.
3582-3594 (1091.8-1095.5)	Limestone, microcrystalline, buff above the seven hardgrounds, and grey beneath. Brachiopods, crinoid ossicles and a few corals. Hardground at base.
3594-3608 (1095.5-1099.7)	Limestone, microcrystalline, slightly argillaceous, dark greenish-grey. Grades down into drab olive-brown, bioturbated, argillaceous microcrystalline dolomite. Unfossiliferous.

	SECOND RED BED MEMBER
3608-3611 (1099.7-1100.6)	Mudstone, dolomitic, grey, well consolidated at top.
3611-3617 (1100.6-1102.5)	Mudstone, dolomitic, brown, riddled with veins of orange halite. Slickensided surfaces. Blocky fracture [Plate 2(1)].
3617-3621 (1102.5-1103.7)	Mudstone, dolomitic, red, riddled with veins of orange halite.
	PRAIRIE EVAPORITE
3621 (1103.7)	Red halite.

Duval Aberdeen 3 30 37 2
Lsd. 3-30-37-2W3
K.B. 1776 ft (542 m)

Dawson Bay Fm: 3079-3195 ft (938-974 m)
Cored Interval: 3140-3195 ft (957-974 m)

Depth in feet (metres)	
	Overlying beds: dolomitic limestone at the top of the Burr Member.
	BURR MEMBER
3140-3165 (957.1-964.7)	Limestone, dolomitic, cryptocrystalline to microcrystalline, pale brown. Faintly mottled. Crinoid ossicles, small gastropods, brachiopod fragments, and rare corals. Scattered needles of brown translucent anhydrite and nodules of blue anhydrite. Seven hardgrounds, plus a well-defined hardground at the base.
3165-3172 (964.7-966.8)	Limestone, dolomitic, slightly argillaceous, grey. Crinoid ossicles and few brachiopods. Scattered nodules of blue anhydrite.
3172-3180 (966.8-969.3)	Limestone, dolomitic, slightly argillaceous, grey. Bioturbated and unfossiliferous.
3180-3182 (969.3-969.9)	Limestone, finely sucrosic, medium brown, well laminated with bituminous laminae, and 4 cm oil shale at the base [Plate 5]. Depositional dip up to 25°.
	SECOND RED BED MEMBER
3182-3192 (969.9-972.9)	Mudstone, dolomitic, grey. Laminated top few cm has been disrupted to form an intraformational breccia [Plate 4(3)], beneath which the sediment is poorly consolidated.
3192-3194 (972.9-973.5)	Mudstone, dolomitic, red, with some green bands. Thin bed of blue anhydrite at 3192 ft (973 m). Lower part intermingled with halite.
	PRAIRIE EVAPORITE
3194 (973.5)	Red halite.

General Petroleums Saskatoon 6 12
Lsd. 6-12-38-4W3
K.B. 1671 ft (509 m)

Dawson Bay Fm: 2854-2968 ft (870-905 m)
Cored Interval: 2931-2968 ft (893-905 m)

Depth in feet (metres)	
	Overlying beds: limestone of the Burr Member.
	BURR MEMBER
2931-2941 (893.4-896.4)	Limestone, microcrystalline, pale brown. Wavy-laminated to pseudo-nodular bedding. Brachiopods and crinoids. Two hardgrounds plus a well-defined hardground at the base.
2941-2951.5 (896.4-899.6)	Limestone, dolomitic, microsucrosic to sucrosic, drab medium-brown to grey. Crinoid ossicles in top half; bioturbated and unfossiliferous lower half [Plate 5(5)]. Porosity plugged with halite.
2951.5-2952 (899.6-899.8)	Limestone, microsucrosic, buff, well laminated with bituminous laminae.
	SECOND RED BED MEMBER
2952-2960 (899.8-902.2)	Mudstone, dolomitic, grey. Finely laminated upper few cm, then poorly lithified. Grades down through olive-brown to brown.

2960-2968 (902.2-904.6)	Mudstone, dolomitic, red with green mottles. Greenish-grey band in lower part.
	PRAIRIE EVAPORITE
2968 (904.6)	Sylvite and halite of the Patience Lake Member.

Goldfield Grt Cdn. Dundurn
10 7 32 5
Lsd. 10-7-32-5W3
K.B. 1716 ft (523 m)

Dawson Bay Fm: 3574-3706 ft (1089-1130 m)
Cored Interval: Entire formation.

Depth in feet (metres)	
	Overlying beds: greenish dolomitic mudstones of the First Red Bed (Souris River Fm.). Gradational contact.
	NEELY MEMBER
3574-3600 (1089.3-1097.3)	Mudstone, dolomitic, greenish-grey, interlaminated with bluish anhydrite. Buff cryptocrystalline dolomite in lower part [Plate 15(5)]. Sediments comprise the transitional beds up into Souris River Fm.
3600-3608 (1097.3-1099.7)	Limestone, cryptocrystalline, greyish-buff. Brown bituminous bands. Halite 'nodules'; brown translucent needles of anhydrite and blebs of blue anhydrite.
3608-3614 (1099.7-1101.5)	Limestone, microcrystalline to sucrosic, grey to buff, indistinctly laminated. Vugs and moulds of gastropods and brachiopods plugged with halite. Elongate nodules of bluish anhydrite up to 2 cm. *Amphipora* and few stromatoporoids.
3614-3626 (1101.5-1105.2)	Limestone, dolomitic, sucrosic, medium brown to black, bituminous. Reefoid in appearance. Fauna includes *Amphipora*, large stromatoporoids (>20 cm), favositid corals, solitary corals, and stringocephalid and atrypid brachiopods. Porosity plugged with halite.
3626-3640 (1105.2-1109.5)	Limestone, slightly dolomitic, microcrystalline to sucrosic, pale olive-brown. Few small stromatoporoids, scattered brachiopods and corals. Pale orange organic globules at 3636 ft (1108 m). Porosity plugged with halite. Hardground at the base.
3640-3643 (1109.5-1110.4)	Limestone, microcrystalline, argillaceous, grey. Stromatoporoids (some broken), brachiopods, corals and crinoid ossicles. Hardground at base.
	BURR MEMBER
3643-3680 (1110.4-1121.7)	Limestone, microcrystalline, buff to olive-brown to grey. Wavy-laminated and pseudo-nodular bedding. Eighteen hardgrounds (pale brown above and grey beneath each hardground). Scattered fauna of brachiopods, gastropods, corals and crinoid ossicles (including *Gasterocoma*) locally abundant [Plates 7(1) and (2)]. Some fossil moulds infilled with halite. Some unfossiliferous bands exhibit bioturbation and pyrite networks. Some orange globules of organic matter. Porosity plugged with halite. Basal hardground.
3680-3692 (1121.7-1125.3)	Limestone, microcrystalline, argillaceous, greyish-green. Unfossiliferous and bioturbated [Plate 5(4)]. Faintly laminated. Halite impregnated.
3692-3694 (1125.3-1125.9)	Limestone, microcrystalline and fragmental, medium brown. Fine bituminous laminae. Intraformational breccia at base. Halite impregnated.
	SECOND RED BED MEMBER
3694-3705 (1125.9-1129.3)	Mudstone, dolomitic, grey and lithified in upper part grading down into poorly consolidated greenish-grey mudstone with orange halite filling fractures.
3705-3706 (1129.3-1129.6)	Mudstone, dolomitic, red, intermixed with halite.
	PRAIRIE EVAPORITE
3706 (1129.6)	Red halite.

Duval Saskatoon 6 18 36 6
Lsd. 6-18-36-6W3
K.B. 1649 ft (503 m)

Dawson Bay Fm: 3165-3274 ft (964-998 m)
Cored Interval: Entire formation.

Depth in feet (metres)	
	Overlying beds: greenish-grey dolomitic mudstone with minor anhydrite constituting the gradational contact with the First Red Bed (Souris River Fm.).
	NEELY MEMBER
3165-3172 (964.7-966.8)	Anhydrite, bluish-grey, dense, interbedded with greenish-grey dolomitic mudstone.
3172-3176 (966.8-968.0)	Anhydrite, bluish-grey, dense, bedded. Lower part contains stringers of buff cryptocrystalline dolomite.
3176-3178 (968.0-968.6)	Dolomite, microcrystalline to sucrosic, pale and dark brown, bituminous. Algal mats and algal stromatolites [Plate 13(3)] with bituminous dolomite between the algal heads. Vuggy porosity plugged with halite. Scattered needles of brown translucent anhydrite.
3178-3184 (968.6-970.5)	Limestone, cryptocrystalline, drab medium brown, with ½ - 2 cm bands of dark brown dolomitic limestone that is bituminous, wispy-laminated, and microcrystalline to finely sucrosic. Abundant crinoid ossicles and small shells, especially in the darker bands. Small vertical fractures in the limestone. Vugs and shell moulds filled with halite. Lithoclasts at the base.
3184-3200 (970.5-975.4)	Limestone, microcrystalline, with wider and more diffuse dark brown bands of dolomitic limestone than above. Stromatoporoids, corals and crinoid ossicles. Two minor hardgrounds at 3196 ft (974 m).
3200-3206 (975.4-977.2)	Limestone, dolomitic, microcrystalline to finely sucrosic, drab medium brown. Numerous tiny burrows containing lighter-coloured sediment. Small nodules of blue anhydrite. Low porosity.
3206-3212 (977.2-979.0)	Similar lithology to above, except more argillaceous, larger burrows, and scattered crinoid ossicles.
	(poorly defined contact)
	BURR MEMBER
3212-3247 (979.0-989.7)	Limestone, microcrystalline, pale brown. Bands of wavy-laminae and pseudo-nodular bedding. Moderately fossiliferous: crinoid ossicles, corals, brachiopods (including large atrypids) at 3235 ft (986 m), and carbonized plant fragments at 3226 ft (983 m). Bioturbated in part, and several hardgrounds. Hardground at the base.
3247-3256 (989.7-992.4)	Limestone, microcrystalline, greenish-grey, slightly argillaceous. Indistinctly laminated. Unfossiliferous except for crinoid ossicles in upper part.
3256-3262 (992.4-994.3)	Limestone, dolomitic, finely sucrosic, with bituminous laminae. Good porosity.
	SECOND RED BED MEMBER
3262-3274 (994.3-997.9)	Poor recovery of crumbly grey dolomitic mudstone.
	PRAIRIE EVAPORITE
3274 (997.9)	Red halite with scattered crystals of sylvite.

Tide Water Swanson Crown
No. 2 Lsd. 16-9-32-8W3
K.B. 1753 ft (534 m)

Dawson Bay Fm: 3666-3779 ft (1117-1152 m)
Cored Interval: 3667-3723 ft (1118-1135 m)

Depth in feet (metres)	
	Overlying beds: First Red Bed of the Souris River Fm., and uppermost few cm of Neely Member.

NEELY MEMBER

3667-3674 (1117.7-1119.8)	Anhydrite, bluish-grey, dense, interbedded with green and red dolomitic mudstone that is brecciated in part. Minor laminae of buff cryptocrystalline dolomite in lower few cm.
3674-3687 (1119.8-1123.8)	Limestone, dolomitic, microcrystalline, pale brown. Some bituminous laminae. Some gastropods filled with transparent halite.
3687-3712 (1123.8-1131.4)	Limestone, dolomitic (locally a dolomite), microcrystalline, drab medium-brown. Black organic residues. Stromatoporoids, corals and brachiopods.
3712-3718 (1131.4-1133.2)	Dolomite, microcrystalline, drab olive-brown. Unfossiliferous.

BURR MEMBER

3718-3723 (1133.2-1134.8)	Limestone, dolomitic, microcrystalline, medium-brown. Brachiopods.

Underlying beds: carbonates of the Burr Member (cf. W. James Donovan 16-34-32-8(W3)).

W. James Donovan 16 34 33 8
Lsd. 16-34-33-8W3
K.B. 1740 ft (530 m)

Dawson Bay Fm: 3638-3767 ft (1109-1148 m)
Cored Interval: 3702-3767 ft (1128-1148 m)

Depth in feet (metres)

Overlying beds: uppermost limestone of the Burr Member.

BURR MEMBER

3702-3746 (1128.4-1141.8)	Limestone, dolomitic, microcrystalline, drab medium-brown. Locally mottled. Brachiopods, bryozoans, corals, few small stromatoporoids in upper part, crinoid ossicles [Plate 9(3)]. Scattered nodules of blue anhydrite. Pseudo-nodules with argillaceous cores at 3730 ft (1137 m). Sedimentary boundinage at 3740 ft (1140 m). Seven hardgrounds, plus a diffuse hardground at the base.
3746-3751.5 (1141.8-1143.5)	Limestone, microcrystalline, argillaceous, grey. Unfossiliferous.
3751.5-3754 (1143.5-1144.2)	Limestone, microcrystalline, pale brown. Upper part laminated and argillaceous; middle is interbedded with anhydrite; base has bituminous laminae, grading down into 4 cm of oil-shale dipping at 15°. Gradational lower contact.

SECOND RED BED MEMBER

3754-3764 (1144.2-1147.3)	Mudstone, dolomitic, grey. Top few cm laminated and well lithified. Underlying beds poorly consolidated.
3764-3767 (1147.3-1148.2)	Mudstone, dolomitic, red with greenish bands and some halite.

PRAIRIE EVAPORITE

3767 (1148.2)	Halite.

Cdn. Expl. Langham A1 2 39 8
Lsd. 1-2-39-8W3
K.B. 1662 ft (507 m)

Dawson Bay Fm: 2931-3042 ft (893-927 m)
Cored Interval: Entire formation.

Depth in feet (metres)

Overlying beds: red and greenish-grey dolomitic mudstones of the First Red Bed of the Souris River Fm.

NEELY MEMBER

2931-2935 (893.4-894.6)	Mudstone, dolomitic, green, interbedded with lesser amounts of bluish anhydrite.
2935-2936 (894.6-894.9)	Anhydrite, bluish, dense, interbedded with pale brown microcrystalline dolomite.
2936-2939 (894.9-895.8)	Dolomite, microcrystalline, medium brown. Porosity plugged with halite.
2939-2946 (895.8-897.9)	Dolomite, microcrystalline to sucrosic, black and bituminous. Powdery in part. Vugs and pores plugged with bituminous halite.

2946-2970 (897.9-905.3)	Dolomite, sucrosic, medium brown to grey. Abundant vugs plugged with halite. Scattered nodules of blue anhydrite (< 4 cm). Crinoid ossicles. Base bounded by diffuse hardground, above which occur corals and ossicles of the two-holed crinoid *Gasterocoma* [Plate 1(1)].
2970-2984 (905.3-909.5)	Dolomite, sucrosic, drab olive-brown. Unfossiliferous and no vugs. Scattered nodules of blue anhydrite, and networks of black pyrite. Diffuse darker brown wavy laminae. Basal few cm is calcareous, and contains corals.
	BURR MEMBER
2984-2994 (909.5-912.5)	Dolomite, sucrosic, drab brown, with approximately equal amounts of microcrystalline brown limestone [Plates 9(1), (2)]. Calcareous patches contain needles of brown translucent anhydrite; dolomitic areas contain networks of black pyrite. Some nodules of blue anhydrite (< 2 cm). Crinoid ossicles. Five diffuse hardgrounds.
2994-3022 (912.5-921.1)	Limestone, dolomitic, microcrystalline, pale greyish-brown to buff. Brachiopods, crinoid ossicles, one small stromatoporoid at 3005 ft (916 m). Some bands of bioturbated and unfossiliferous sediment. Four hardgrounds, plus well-defined hardground at the base.
3022-3026 (921.1-922.3)	Limestone, slightly dolomitic, argillaceous, finely sucrosic, olive-grey. Bioturbated and unfossiliferous.
3026-3030 (922.3-923.5)	Limestone, upper part dolomitic, microcrystalline, buff. Finely laminated with bituminous laminae.
	SECOND RED BED MEMBER
3030-3036 (923.5-925.4)	Mudstone, dolomitic, grey, fissile.
3036-3039 (925.4-926.3)	Mudstone, dolomitic, greenish-grey. Massive with blocky fracture.
3039-3042 (926.3-927.2)	Mudstone, dolomitic, red and brown with green bands. One cm-thick band of blue anhydrite just above the base.
	PRAIRIE EVAPORITE
3042 (927.2)	Halite.

Continental Potash Arelee
7 4 38 11
Lsd. 7-4-38-11W3
K.B. 1806 ft (550 m)

Dawson Bay Fm: 3415 ft (1041 m) and base not reached
Cored Interval: 3415-3495 ft (1041-1065 m)

Depth in feet (metres)	
	Overlying beds: red and green dolomitic mudstones of the First Red Bed of the Souris River Fm.
	NEELY MEMBER
3415-3417 (1040.9-1041.5)	Limestone, microcrystalline, dark brown, bituminous. Vugs lined with white calcite and infilled with transparent halite.
3417-3433 (1041.5-1046.4)	Limestone, microcrystalline, buff to dark brown. Irregular bituminous bands. Crinoid ossicles. Bituminous veneers (? incipient stylolites). Fractures between 38° and 45° from horizontal. Base is well-defined hardground dipping at about 25°.
	PROBABLE TOP OF BURR MEMBER (?)
3433-3468 (1046.4-1057.0)	Limestone, microcrystalline to finely sucrosic, medium brown. Slightly bituminous. Very few fossils. Three hardgrounds near top dip from 15°-30°. Beneath 3440 ft (1049 m) there are abundant fractures dipping from 20° to 90°. Vertical strain-marks in massive sucrosic crinoidal limestone at 3460 ft (1055 m). Possible fault at 3462 ft (1055.2 m) filled with 8 cm of coarsely crystalline clear halite.
3468-3485 (1057.0-1062.2)	Limestone, microcrystalline, drab medium brown. Abundant fractures infilled with halite in upper part; few fractures in lower part.

3485-3495 (1062.2-1065.3) Limestone, microcrystalline, argillaceous, dark grey. Unfossiliferous. Near vertical fractures, occasionally infilled with halite.

Bottom of cored section.

Ceepee Riley Lake 3-4
Lsd. 3-4-39-13W3
K.B. 2385 ft (727 m)

Dawson Bay Fm: 3800-3902 ft (1158-1189 m)
Cored Interval: 3804-3834 ft (1159-1169 m)

Depth in feet (metres)

Overlying beds: dolomitic mudstones of the First Red Bed of the Souris River Fm.

NEELY MEMBER

3804-3834 (1159.5-1168.6) Dolomite, microcrystalline to sucrosic, drab medium brown. Abundant irregular vugs up to 3 cm lined with sucrosic dolomite and infilled with transparent crystalline gypsum [Plate 18(4)]. Upper part is black and carbon-rich. Some white fibrous anhydrite after gypsum. Black networks of pyrite, probably after anhydrite. Incipient stylolites. Fauna comprises *Amphipora* and crinoid ossicles, with rare corals. Fewer vugs and more argillaceous beneath 3830 ft (1167 m).

Bottom of cored interval

Imperial Fortune 13 20 30 14
Lsd. 13-20-30-14W3
K.B. 1946 ft (593 m)

Dawson Bay Fm: 4572-4689 ft (1394-1429 m)
Cored Interval: 4643-4689 ft (1415-1429 m)

Depth in feet (metres)

Overlying beds: brecciated carbonates.

SECOND RED BED MEMBER (?)

4643-4689 (1415.2-1429.2) Polymict intraformational breccia. Entire sequence is red dolomitic mudstone comparable to basal sediments of the Second Red Bed Member elsewhere, but contains abundant brecciated clasts of angular to sub-rounded anhydrite, carbonate and mudstone [Plate 21(1)]. Some large clasts (>10 cm) of limestone show shearing, outlined by preferred orientation of crinoid ossicles. Anhydrite clasts are confined largely to the lower half of the sequence.

Logs indicate that underlying beds probably consist of more breccia before carbonates of the Winnipegosis Fm. are reached.

Ceepee Keppel Forest 8 3
Lsd. 8-3-40-14W3
K.B. 2432 ft (741 m)

Dawson Bay Fm: 3746-3857 ft (1142-1176 m)
Cored Interval: 3774-3799 ft (1150-1158 m)

Depth in feet (metres)

Overlying beds: carbonates of the upper Neely Member.

NEELY MEMBER

3774-3792 (1150.3-1155.8) Dolomite, sucrosic, drab dark olive-brown. Large vugs (2-3 cm) plugged with halite. Generally structureless except for diffuse bedding and a small-scale intraformational breccia at 3781 ft (1152 m). A 50 cm band of limestone between two vestigial hardgrounds occurs at 3784 ft (1153 m). Lower part of sequence has no vugs, is calcareous and laminated.

BURR MEMBER

3792-3799 (1155.8-1157.9) Dolomite, sucrosic, drab olive-brown, mottled. Vugs plugged with halite. Scattered nodules of blue anhydrite. Lowermost part is calcareous.

Bottom of cored section.

APPENDIX III

DRILL-STEM-TEST DATA

LSD	Dawson Bay Interval	Drill-Stem-Test Interval	Pressures (psi) Shut-In Initial	Shut-In Final	Flowing Initial	Flowing Final	Recovery
14-3-30-20W2	3223-3355 ft (982-1023) m	3146-3251 ft (959-991) m	380	229	134	131	6.1 m (20') clean mud
8-20-33-20W2	2940-3106 ft (896-947) m	2986-3096 ft (910-944) m	257	58	14	15	3.0 m (10') clean mud
15-14-40-20W2	2641-2758 ft (805-841) m	2642-2669 ft (805-814) m		800		200	137.2 m (450') salt water
10-29-29-21W2	3426-3610 ft (1044-1100) m	3480-3510 ft (1061-1070) m		30		40	.6 m (2') clean mud
16-2-30-21W2	3273-3432 ft (998-1046) m	3300-3330 ft (1006-1015) m	86	118	29	29	6.1 m (20') clean mud
5-34-30-21W2	3229-3354 ft (984-1022) m	3234-3264 ft (986-995) m	865	700	30	30	1.5 m (5') clean mud
8-32-31-21W2	3130-3302 ft (954-1006) m	3050-3210 ft (930-978) m	158	123	8	8	3.0 m (10') clean mud
12-34-33-21W2	2895-3050 ft (882-930) m	2965-3043 ft (904-928) m	28	28	0	0	3.0 m (10') clean mud
4-32-34-21W2	2869-2994 ft (874-913) m	2850-2991 ft (869-912) m					7.6 m (25') clean mud
13-4-35-21W2	2886-3023 ft (880-921) m	2850-3002 ft (869-915) m		320	105	105	54.9 m (180') clean mud
13-6-35-21W2	2945-3080 ft (898-939) m	2930-3045 ft (893-928) m	60	30	15	15	1.5 m (5') clean mud
13-16-35-21W2	2863-3009 ft (873-917) m	2860-3000 ft (872-914) m					2.4 m (8') clean mud
6-2-37-21W2	2828-2958 ft (862-902) m	2840-2880 ft (866-878) m		964	44	140	76.2 m (250') mud cut water
4-29-32-22W2	3110-3258 ft (948-993) m	3141-3175 ft (957-968) m	1750				19.8 m (65') clean mud
16-29-38-22W2	2654-2788 ft (809-850) m	2658-2685 ft (810-818) m		850	0	0	salt water 45.7 m (150') cut mud
9-29-29-23W2	3328-3462 ft (1014-1055) m	3378-3394 ft (1030-1034) m		0	0	0	salt water 1.5 m (5') cut mud
1-12-30-23W2	3315-3457 ft (1011-1054) m	3300-3450 ft (1006-1052) m	133	126	24	24	1.5 m (5') clean mud
5-15-30-23W2	3316-3455 ft (1011-1053) m	3308-3474 ft (1008-1059) m	600	470	215	215	6.1 m (20') clean mud
12-20-30-23W2	3251-3402 ft (991-1037) m	3210-3406 ft (978-1038) m	486	215	135	135	4.6 m (15') clean mud
1-24-30-23W2	3299-3450 ft (1006-1052) m	3280-3426 ft (1000-1044) m	242	197	23	18	salt water 3.0 m (10') cut mud
1-34-30-23W2	3253-3422 ft (992-1043) m	3230-3410 ft (985-1039) m	261	186	28	24	3.0 m (10') clean mud
1-36-30-23W2	3248-3414 ft (990-1041) m	3220-3405 ft (981-1038) m	233	170	27	26	3.0 m (10') clean mud
16-4-31-23W2	3247-3392 ft (990-1034) m	3240-3387 ft (988-1032) m	108	149	21	17	6.1 m (20') clean mud
16-6-31-23W2	3222-3360 ft (982-1024) m	3200-3350 ft (975-1021) m	196	318	22	22	1.8 m (6') clean mud

LSD	Dawson Bay Interval	Drill-Stem-Test Interval	Pressures (psi) Shut-In Initial	Shut-In Final	Flowing Initial	Flowing Final	Recovery
8-2-33-23W2	3063-3193 ft (934-973) m	3035-3181 ft (925-970) m	85	30	0	0	6.1 m (20') clean mud
8-3-33-23W2	3073-3212 ft (937-979) m	3047-3208 ft (929-978) m	57	61	13	13	1.5 m (5') clean mud
21-12-4-33-23W2	3090-3228 ft (942-984) m	3076-3210 ft (938-978) m	130	130	55	55	1.5 m (5') clean mud
31-12-4-33-23W2	3089-3226 ft (942-983) m	2770-3220 ft (844-981) m	696	403	35	35	1.5 m (5') clean mud
12-16-33-23W2	3066-3192 ft (935-973) m	2898-3140 ft (893-957) m	290	210	145	145	6.1 m (20') clean mud
		3140-3182 ft (957-970) m	50	32	32	32	3.0 m (10') clean mud
9-22-33-23W2	3072-3201 ft (936-976) m	3042-3196 ft (927-974) m	380	250	180	180	39.6 m (130') clean mud
9-26-33-23W2	3010-3143 ft (917-958) m	3000-3135 ft (914-956) m	185	155	15	15	4.6 m (15') clean mud
11-4-28-33-23W2	3083-3213 ft (940-979) m	2778-3203 ft (847-976) m		585		349	4.6 m (15') clean mud
21-4-28-33-23W2	3090-3220 ft (942-981) m	3060-3206 ft (933-977) m					.9 m (3') clean mud
2-30-33-23W2	3143-3287 ft (958-1002) m	3140-3282 ft (957-1000) m	1520	1520	30	85	42.7 m (140') clean mud
13-34-33-23W2	3085-3227 ft (940-984) m	3104-3147 ft (946-959) m		1800		0	salt water 4.6 m (15') cut mud
3-10-34-23W2	3039-3177 ft (926-968) m	3010-3163 ft (917-964) m	50	40	30	30	10.7 m (35') clean mud
4-18-35-23W2	3027-3149 ft (923-960) m	3032-3134 ft (924-955) m		1170		295	105.5 m (346') salt water
4-16-29-24W2	3506-3622 ft (1069-1104) m	3498-3523 ft (1066-1074) m		1450		675	426.7 m (1400') salt water
4-28-29-24W2	3502-3634 ft (1067-1108) m	3520-3534 ft (1073-1077) m		1450	0	750	mud cut 445.0 m (1460') salt water
4-16-31-24W2	3390-3505 ft (1033-1068) m	3380-3430 ft (1030-1045) m		1430		410	237.7 m (780') salt water
		3437-3486 ft (1048-1063) m		1325		0	12.2 m (40') salt water
1-10-33-24W2	3138-3290 ft (956-1003) m	3133-3276 ft (955-999) m		205	20	25	9.1 m (30') clean mud
6-29-33-24W2	3168-3294 ft (966-1004) m	3146-3270 ft (959-997) m		1218		1225	736.1 m (2415') salt water
9-34-33-24W2	3093-3219 ft (943-981) m	3085-3214 ft (940-980) m	475	350	45	60	33.5 m (110') clean mud
16-12-34-24W2	3078-3215 ft (938-980) m	3165-3209 ft (965-978) m		30		25	0.9 m (3') clean mud
13-24-31-25W2	3456-3584 ft (1053-1092) m	3470-3520 ft (1058-1073) m		1400		440	146.3 m (480') salt water
		3520-3585 ft (1073-1093) m		1250		0	51.8 m (170') salt water

LSD	Dawson Bay Interval	Drill-Stem-Test Interval	Pressures (psi) Shut-In Initial	Shut-In Final	Flowing Initial	Flowing Final	Recovery
4-2-32-25W2	3715-3860 ft (1132-1177) m	3690-3808 ft (1125-1161) m				500	mud cut 128.0 m (420') salt water
		3832-3854 ft (1168-1175) m				900	mud cut 164.6 m (540') salt water
10-21-32-25W2	3318-3463 ft (1011-1056) m	3302-3451 ft (1006-1052) m	1349	1336	470	1218	mud cut 676.7 m (2220') salt water
4-13-35-25W2	3073-3195 ft (937-974) m	3075-3187 ft (937-971) m	272	254	18	18	6.1 m (20') clean mud
4-16-35-25W2	3137-3276 ft (956-999) m	3150-3256 ft (960-992) m	138	70	32	14	.6 m (2') clean mud
13-24-35-25W2	3035-3173 ft (925-967) m	3054-3154 ft (931-961) m	161	161	29	14	1.2 m (4') clean mud
1-35-35-25W2	3060-3192 ft (933-973) m	3065-3185 ft (934-971) m	154	112	23	23	3.0 m (10') clean mud
4-21-36-25W2	3002-3137 ft (915-956) m	2996-3109 ft (913-948) m	52		27	31	3.0 m (10') clean mud
4-19-36-26W2	2978-3104 ft (908-946) m	2969-3045 ft (905-928) m	47		11	11	3.0 m (10') clean mud
15-32-31-27W2	3535-3669 ft (1077-1118) m	3548-3654 ft (1081-1114) m	1235	55	27	27	3.0 m (10') clean mud
9-20-34-27W2	3138-3274 ft (956-998) m	3153-3270 ft (961-997) m	104	57	20	20	6.1 m (20') clean mud
16-21-34-27W2	3182-3314 ft (970-1010) m	3166-3251 ft (965-991) m	24	167	19	19	1.2 m (4') clean mud
		3251-3310 ft (991-1009) m	53	19	17	18	1.2 m (4') clean mud
5-33-34-27W2	3157-3284 ft (962-1001) m	3115-3165 ft (949-965) m	30	10	5	5	1.8 m (6') clean mud
		3162-3215 ft (964-980) m	35	18	5	5	1.2 m (4') clean mud
		3215-3275 ft (980-998) m	8	5	3	3	1.2 m (4') clean mud
16-32-36-27W2	3066-3196 ft (935-974) m	3069-3139 ft (935-957) m	49		26	27	1.5 m (5') clean mud
4-29-32-28W2	3449-3582 ft (1051-1092) m	3462-3580 ft (1055-1091) m	286	286	17	17	3.0 m (10') clean mud
16-33-33-28W2	3190-3318 ft (972-1011) m	3188-3242 ft (972-988) m		10		10	3.0 m (10') clean mud
12-11-35-28W2	3130-3252 ft (954-991) m	3120-3248 ft (951-990) m		1170		275	109.7 m (360') salt water
16-36-36-28W2	3010-3130 ft (917-954) m	3010-3080 ft (917-939) m		1670		1665	283.5 m (930') salty mud
1-15-37-28W2	3105-3232 ft (946-985) m	3106-3231 ft (947-985) m	222		23	23	1.5 m (5') clean mud
9-29-30-1W3	4030-4163 ft (1228-1269) m	4042-4090 ft (1232-1247) m	474	176	7	17	0.9 m (3') clean mud
4-10-33-1W3	3472-3602 ft (1058-1098) m	3495-3541 ft (1066-1079) m		0	0	0	3.0 m (10') clean mud

LSD	Dawson Bay Interval	Drill-Stem-Test Interval	Pressures (psi)				Recovery
			Shut-In		Flowing		
			Initial	Final	Initial	Final	
1-12-34-1W3	3265-3384 ft (995-1031) m	3272-3382 ft (997-1031) m		1325		788	444.4 m (1458') salt water
16-14-34-1W3	3233-3359 ft (985-1024) m	3210-3358 ft (978-1024) m		70		50	6.1 m (20') clean mud
1-17-34-1W3	3274-3399 ft (998-1036) m	3093-3293 ft (943-1004) m		200		40	3.0 m (10') clean mud
		3260-3390 ft (994-1033) m		122		30	1.2m (4') clean mud
5-22-34-1W3	3232-3361 ft (985-1024) m	3211-3261 ft (979-994) m		1162		87	15.2 m (50') clean mud
		3260-3311 ft (994-1009) m		498		109	18.3 m (60') clean mud
		3311-3355 ft (1009-1023) m		196		116	51.8 m (170') clean mud
1-25-34-1W3	3283-3410 ft (1001-1039) m	3272-3319 ft (997-1012) m		60		65	64.0 m (210') clean mud
9-26-34-1W3	3196-3321 ft (974-1012) m	3177-3320 ft (968-1012) m		505			1.5 m (5') clean mud
9-27-34-1W3	3180-3305 ft (969-1007) m	3158-3295 ft (963-1004) m		762		128	0.9 m (3') clean mud
9-28-34-1W3	3179-3306 ft (969-1008) m	3156-3290 ft (962-1003) m		410		305	1.5 m (5') clean mud
4-29-34-1W3	3206-3326 ft (977-1014) m	3199-3320 ft (975-1012) m		1003		0	2.4 m (8') clean mud
9-33-34-1W3	3162-3290 ft (964-1003) m	3125-3275 ft (953-998) m		770		20	3.0 m (10') clean mud
8-34-34-1W3	3164-3280 ft (964-1000) m	3164-3275 ft (964-998) m		235		68	64.0 m (210') clean mud
9-35-34-1W3	3155-3275 ft (962-998) m	3110-3262 ft (948-994) m		35		0	1.2 m (4') clean mud
6-16-38-1W3	3016-3135 ft (919-956) m	3033-3068 ft (924-935) m	1105	920	15	60	mud cut 27.4 m (90') salt water
4-22-36-2W3	3218-3340 ft (981-1018) m	3200-3490 ft (975-1064) m		600		240	10.7 m (35') clean mud
1-34-35-3W3	3333-3444 ft (1016-1050) m	3331-3427 ft (1015-1045) m		1425		475	mud cut 228.6 m (750') salt water
		3385-3427 ft (1032-1045) m		0		0	0.9 m (3') clean mud
13-2-36-3W3	3174-3295 ft (967-1004) m	3155-3290 ft (962-1003) m		1350		250	salt water 106.7 m (350') cut mud
11-9-36-3W3	3198-3320 ft (975-1012) m	3195-3253 ft (974-992) m	1364	1293	64	382	86.9 m (285') clean mud 91.4 m (300') salt water
		3253-3305 ft (992-1007) m	1131	1308	24	25	1.5 m (5') clean mud
6-16-36-3W3	3150-3270 ft (960-997) m	3241-3275 ft (988-998) m		0		0	9.1 m (30') clean mud
4-4-37-3W3	3135-3248 ft (956-990) m	3135-3248 ft (956-990) m		1480		1175	628.2 (2061') salt water

LSD	Dawson Bay Interval	Drill-Stem-Test Interval	Pressures (psi)				Recovery
			Shut-In		Flowing		
			Initial	Final	Initial	Final	
		3185-3248 ft (971-990) m		1325		0	4.6 m (15') clean mud
16-24-39-4W3	2722-2842 ft (830-866) m	2700-2745 ft (823-837) m	1150	1125	150	575	487.7 m (1600') salt water
13-36-41-4W3	2615-2732 ft (797-833) m	2703-2740 ft (824-835) m				0	salt water 12.2 m (40') cut mud
10-7-32-5W3	3574-3706 ft (1089-1130) m	3600-3715 ft (1097-1132) m	793	174	26	26	3.0 m (10') clean mud
8-17-32-5W3	3528-3655 ft (1075-1114) m	3539-3559 ft (1079-1085) m			0	0	salt water 1.5 m (5') cut mud
4-4-36-6W3	3272-3387 ft (997-1032) m	3270-3388 ft (997-1033) m		1440		170	39.6 m (130') salt water
5-7-36-6W3	3198-3312 ft (975-1009) m	3205-3305 ft (977-1007) m	430	430	15	19	6.1 m (20') clean mud
1-16-36-6W3	3230-3342 ft (985-1019) m	3233-3320 ft (985-1012) m	1452	1360	113	669	91.1 m (299') clean mud 318.2 m (1044') salt water
6-18-36-6W3	3162-3274 ft (964-998) m	2952-3238 ft (900-987) m	1319	1257	64	207	18.3 m (60') clean mud 73.2 m (240') salt water
		3240-3292 ft (988-1003) m	1378	1345	28	35	15.2 m (50') clean mud
14-28-36-6W3	3180-3296 ft (969-1005) m	3187-3220 ft (971-981) m				0	9.1 m (30') clean mud
5-30-36-6W3	3197-3309 ft (974-1009) m	3200-3296 ft (975-1005) m	1461	769	32	65	19.8 m (65') clean mud
1-25-35-7W3	3280-3395 ft (1000-1035) m	3285-3380 ft (1001-1030) m	652	340	61	61	6.1 m (20') clean mud
16-34-35-7W3	3288-3406 ft (1002-1038) m	3300-3400 ft (1006-1036) m	520	286	40	50	3.0 m (10') clean mud
4-16-36-7W3	3264-3384 ft (995-1031) m	3275-3370 ft (998-1027) m	1657	1428	114	140	56.4 m (185') clean mud
1-32-36-7W3	3123-3235 ft (952-986) m	3127-3220 ft (953-981) m	951	457	63	63	4.6 m (15') clean mud
4-28-37-7W3	3068-3184 ft (935-970) m	3067-3183 ft (935-970) m		0		0	4.6 m (15') clean mud
12-30-38-7W2	3038-3152 ft (926-961) m	3020-3140 ft (920-957) m	531	442	9	9	9.1 m (30') clean mud
16-6-39-7W3	2925-3044 ft (892-928) m	2912-3038 ft (888-926) m	1280	1224	74	191	82.3 m (270') clean mud
16-18-39-7W3	2891-3009 ft (881-917) m	2880-3000 ft (878-914) m	1046	1038	15	15	9.1 m (30') clean mud
16-9-32-8W3	3666-3779 ft (1117-1152) m	3674-3694 ft (1120-1126) m		820		0	10.7 m (35') clean mud
		3689-3723 ft (1124-1135) m		0		0	7.6 m (25') clean mud
16-34-32-8W3	3638-3767 ft (1109-1148) m	3638-3752 ft (1109-1144) m	234	156	16	39	9.1 m (30') clean mud
16-22-33-8W3	3569-3684 ft (1088-1123) m	3538-3688 ft (1078-1124) m	814	82	36	36	3.0 m (10') clean mud

LSD	Dawson Bay Interval	Drill-Stem-Test Interval	Pressures (psi) Shut-In Initial	Shut-In Final	Flowing Initial	Flowing Final	Recovery
16-28-34-8W3	3500-3609 ft (1067-1100) m	3470-3603 ft (1058-1098) m	655	52	40	40	6.1 m (20') clean mud
15-32-34-8W3	3516-3615 ft (1072-1102) m	3483-3613 ft (1062-1101) m	235	120	22	22	1.5 m (5') clean mud
13-1-35-8W3	3447-3556 ft (1051-1084) m	3416-3548 ft (1041-1081) m	440	210	110	110	57.9 m (190') clean mud
16-6-35-8W3	3420-3531 ft (1042-1076) m	3395-3528 ft (1035-1075) m	240	173	140	142	42.7 m (140') clean mud
16-8-35-8W3	3388-3495 ft (1033-1065) m	3358-3492 ft (1024-1064) m	366	318	36	36	32.0 m (105') clean mud
4-10-35-8W3	3385-3496 ft (1032-1066) m	3352-3505 ft (1022-1068) m	1709	133	82	95	36.6 m (120') clean mud
13-11-35-8W3	3356-3464 ft (1023-1056) m	3330-3463 ft (1015-1056) m	132	136	41	43	4.6 m (15') clean mud
11-16-35-8W3	3381-3488 ft (1031-1063) m	3110-3476 ft (948-1059) m	1290	1258	57	91	36.6 m (120') clean mud
		3225-3476 ft (983-1059) m	223	312	28	28	3.0 m (10') clean mud
13-16-35-8W3	3355-3465 ft (1023-1056) m	3324-3463 ft (1013-1056) m	35	33	33	33	1.5 m (5') clean mud
4-18-35-8W3	3418-3530 ft (1042-1076) m	3385-3521 ft (1032-1073) m	1635	1612	56	77	56.7 m (186') clean mud 1.2 m (4') salt water
		3440-3521 ft (1049-1073) m	1661	1490	39	44	27.4 m (90') clean mud
4-20-35-8W3	3375-3484 ft (1029-1062) m	3345-3482 ft (1020-1061) m	692	1051	692	966	45.7 m (150') clean mud
4-22-35-8W3	3380-3491 ft (1030-1064) m	3456-3476 ft (1053-1059) m	30	29	27	27	6.1 m (20') clean mud
		3410-3476 ft (1039-1059) m	55	29	23	23	6.1 m (20') clean mud
		3390-3480 ft (1033-1061) m	614	138	36	45	6.1 m (20') clean mud
13-23-35-8W3	3295-3402 ft (1004-1037) m	3260-3394 ft (994-1034) m	323	157	24	24	0.9 m (3') clean mud
4-24-35-8W3	3369-3478 ft (1027-1060) m	3335-3476 ft (1017-1059) m	568	285	100	100	57.9 m (190') clean mud
4-28-35-8W3	3273-3384 ft (998-1031) m	3260-3376 ft (994-1029) m	1070	120	83	97	21.3 m (70') clean mud
14-29-35-8W3	3290-3397 ft (1003-1035) m	3260-3393 ft (994-1034) m	1484	1475	30	112	salt water 61.0 m (200') cut mud
		3306-3393 ft (1008-1034) m	378	262	53	54	1.5 m (5') clean mud
4-30-35-8W3	3435-3542 ft (1047-1080) m	3400-3527 ft (1036-1075) m	1586	1583	71	255	70.1 m (230') clean mud 57.9 m (190') salt water
		3494-3527 ft (1065-1075) m	287	32	32	32	4.6 m (15') clean mud
		3454-3527 ft (1053-1075) m	1144	608	42	44	6.1 m (20') clean mud

LSD	Dawson Bay Interval	Drill-Stem-Test Interval	Pressures (psi)				Recovery
			Shut-In		Flowing		
			Initial	Final	Initial	Final	
4-34-35-8W3	3287-3396 ft (1002-1035) m	3256-3390 ft (992-1033) m	285	75	22	22	3.0 m (10') clean mud
13-28-38-8W3	2929-3042 ft (893-927) m	2927-3027 ft (892-923) m	21	12	10	10	0.3 m (1') clean mud
1-2-39-8W3	2931-3042 ft (893-927) m	2915-3039 ft (888-926) m	1315	1260	113	113	30.5 m (100') clean mud
4-11-35-9W3	3586-3695 ft (1093-1126) m	3557-3680 ft (1084-1122) m	110	67	40	41	1.5 m (5') clean mud
4-12-35-9W3	3544-3655 ft (1080-1114) m	3510-3647 ft (1070-1112) m	1724	1632	49	63	0.6 m (2') salt water 20.7 m (68') clean mud
		3556-3647 ft (1084-1112) m	1746	1657	47	63	salt water 21.3 m (70') cut mud
		3600-3647 ft (1097-1112) m	1757	1682	41	57	salt water 21.3 m (70') cut mud
		3520-3601 ft (1073-1098) m	1579	1484	198	804	451.1 m (1480') salt water
16-22-35-9W3	3501-3609 ft (1067-1100) m	3570-3601 ft (1088-1098) m	1556	1459	34	71	21.3 m (70') salt water
4-24-35-9W3	3437-3547 ft (1048-1081) m	3408-3542 ft (1039-1080) m	1552	1525	60	254	64.0 m (210')clean mud mud cut 73.2 m (240') salt water
		3470-3542 ft (1058-1080) m	190	35	37	34	6.1 m (20') clean mud
4-36-35-9W3	3412-3520 ft (1040-1073) m	3382-3516 ft (1031-1072) m	1573	1567	115	325	salt water 88.4 m (290') cut mud 61.0 m (200') salt water
		3435-3516 ft (1047-1072) m	1558	1558	51	171	86.9 m (285') salt water
		3448-3516 ft (1051-1072) m	1570	1566	41	120	salt water 59.4 m (195') cut mud
		3472-3516 ft 1058-1072) m	1564	1564	35	89	13.7 m (45') clean mud 30.5 m (100') salt water
2-4-35-12W3	3662-3774 ft (1116-1150) m	3600-3740 ft (1097-1140) m	716	607	17	33	36.6 m (120') clean mud

APPENDIX IV

ROCK MECHANICS PROCEDURES

Uniaxial Compression Tests

Core specimens of approximately 4 cm (1.5 inches) in diameter by 12 cm (5 inches) in length were cut on a diamond saw using water as a lubricating and cooling fluid. They were not water-saturated because their porosities were extensively plugged with halite. The samples were cut with a height-to-diameter ratio of approximately 2.1 to 1. Their plane surfaces were ground parallel to each other and perpendicular to the cylindrical axis in a special jig on a reciprocating surface grinder. The specimens were then dried in a vacuum oven held at 105°C.

Five strain gauges were cemented to the cylindrical surface of each specimen on the centre line. Three gauges were oriented to sense the axial strain and two the lateral strain on the specimen as it was subjected to uniaxial compression. Tests were carried out at normal room temperature and humidity (about 30 percent).

Specimens were then subjected to uniaxial compression in a 180,000 kN capacity Tinius Olsen Compression Testing machine. The axial and lateral strains were recorded as a function of axial load applied at a rate between readings of 689.5 kPa (100 psi) per second, until failure of the specimen occurred. Failure was in all cases explosive in nature, with signs of prior vertical splitting.

Indirect Tension Tests

Specimens were cut with a diamond saw from the core samples to a thickness of approximately 12 mm (0.5 inches). Their plane surfaces were ground parallel to each other and perpendicular to the cylindrical axis in a special jig on a reciprocating surface grinder. The specimens were then dried in a vacuum oven held at 105°C, and tests carried out at normal room temperature and humidity.

Steel loading platens for diametral compression were cemented at the extremities of a diameter on each specimen. The specimens were then subjected to diametral loading at a rate of approximately 138 kPa (20 psi) per second tensile stress, until failure occurred. The load at failure was recorded and the corresponding tensile strength calculated for each specimen.

APPENDIX V

PLATES

Plate 1 Ossicle of Gasterocoma (1), and Cored Sections to Illustrate Main Stratigraphic Contacts

Plate 1 (1): Photomicrograph, nicols crossed.

Ossicle of the two-hole crinoid *Gasterocoma* set in a matrix of fine-grained dolomite with argillaceous wisps. Upper part of ossicle appears slightly corroded.

Member: Lowermost Neely, immediately above hardground.
Location: Cdn. Expl. Langham A1 2 39 8 (Lsd. 1-2-39-8W3). 2970 ft (905 m).

Plate 1 (2): Core.

Contact between laminated, slumped and eroded dolomitic mudstone of the Second Red Bed Member and overlying disturbed bedding of bituminous microsucrosic dolomite of the Burr Member. The uppermost few centimetres are calcareous. Note: 1) thin oil-shale at 'a' and the angular discordance between strata above and below; 2) slumped strata at 'b'; 3) eroded surfaces 'c'; 4) pyritic streaks 'd'; 5) microbreccia 'e'.

Member: Contact of Second Red Bed and Burr.
Location: Kennco 3 Prudhomme 12 10 38 28 (Lsd. 12-10-38-28W2). 3052 ft (930 m).

Plate 1 (3): Core.

Hardground 'h' in microcrystalline limestone (slightly dolomitic) of the Burr Member. Above, the sediments are buff and wavy-laminated with abundant faunal fragments, whereas below they are grey, mottled by bioturbation, and contain scattered crinoid ossicles.

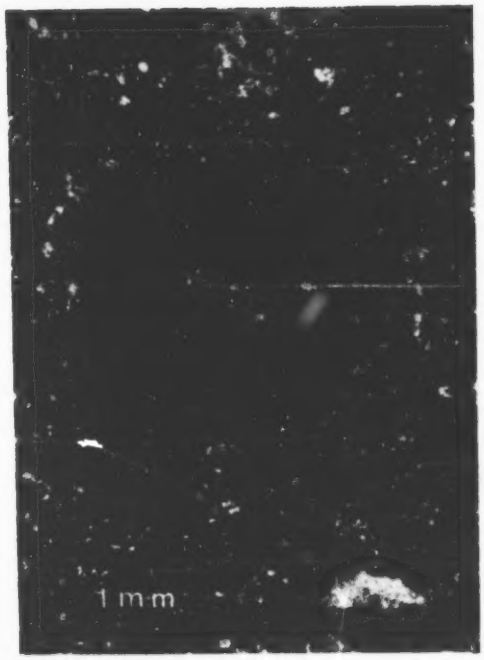
A compound erosion surface is evident: 'a' is the original erosion (or corrosion) surface which was infilled with sediment 'b'. The latter was then eroded prior to deposition of sediment 'c'.

Member: Lower Burr.
Location: Kennco Prudhomme 3 27 38 27 (Lsd. 3-27-38-27W2). 3114 ft (949 m).

Plate 1 (4): Core.

Erosion surface (hardground — 'hgd') between the Burr (beneath) and Neely Members. The Burr Member is medium-grey cryptocrystalline to microcrystalline limestone containing crinoid ossicles. Burrows 'b' are microcrystalline and contain lithoclasts 'L', crinoid ossicles 'cr' and vugs plugged with halite 'h'. Note eroded crinoid ossicle at point 'a'. The Neely lithology is cryptocrystalline drab olive-brown limestone which is slightly argillaceous and bioturbated.

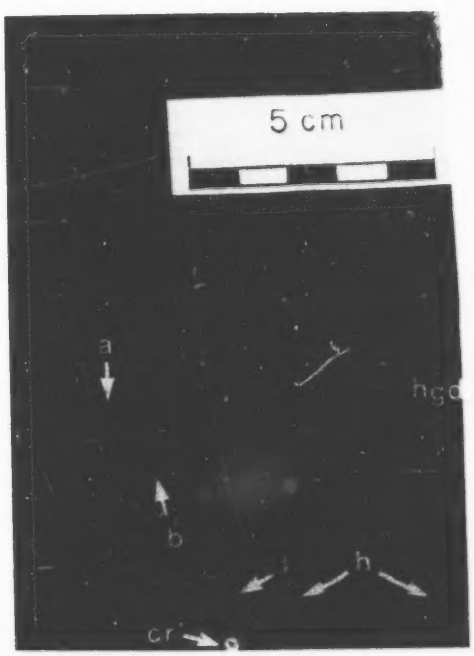
Member: Contact of Burr and Neely (type section of Neely Member.)
Location: Noranda Neely 16 21 34 27 (Lsd. 16-21-34-27W2). 3340 ft (988 m).



1

2

3



4

Plate 2 Second Red Bed Member: Dolomitic Mudstones

Plate 2(1): Core.

'Blocky' fracture pattern of brownish-red dolomitic mudstone accentuated by partial wetting.

Shiny transparent mineral is halite.

Member: Second Red Bed.
Location: Kennco 2-Young 15 36 32 29 (Lsd. 15-36-32-29W2). 3616 ft (1102 m).

Plate 2(2): Core.

Partially wet brownish dolomitic mudstone with well-defined parallel shaly partings. Poorly consolidated lithology.

Member: Second Red Bed.
Location: S W P Boulder Lake 8 25 30 24 (Lsd. 8-25-30-24W2). 3407 ft (1038 m).

Plate 2(3): Core.

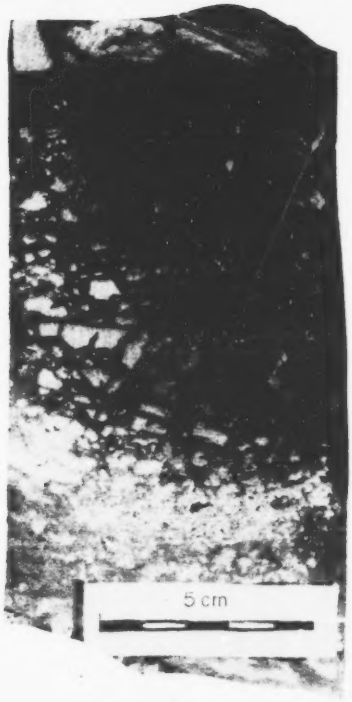
Grey dolomitic mudstone showing natural fractures of the lower homogeneous lithology overlain by a better consolidated intraformational micro-breccia.

Member: Second Red Bed.
Location: Cons Morrison Colonsay 5 33 34 27 (Lsd. 5-33-34-27W2). 3280 ft (1000 m).

Plate 2(4): Core.

Sharp undulating contact between translucent pinkish-white halite of the Prairie Evaporite and encrusting diffusely laminated red and grey dolomitic mudstone of the Second Red Bed. Pore spaces are all plugged with transparent halite.

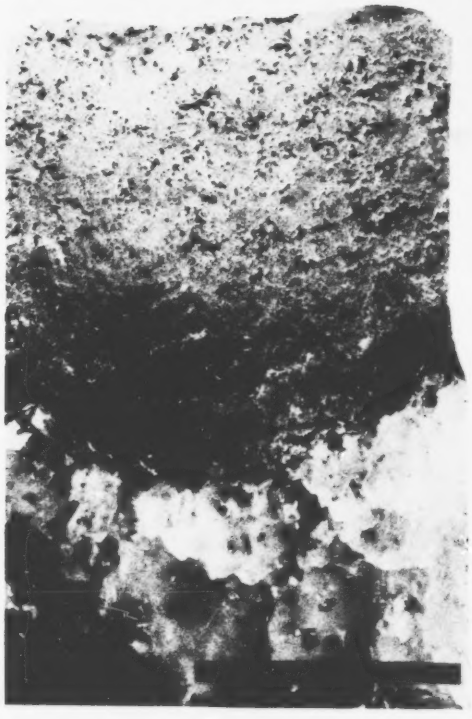
Member: Contact of Prairie Evaporite and Second Red Bed.
Location: K. R. Nokomis 8 7 30 20 (Lsd. 8-7-30-20W2). 3419 ft (1042 m).



1

2

3



4

Plate 3 Gradational Contacts Between the Second Red Bed Member and Underlying Lithologies

Plate 3(1): Core.

Transition from halite of the Prairie Evaporite to red dolomitic mudstone (intermixed with halite) of the Second Red Bed.

Member: Contact of the Prairie Evaporite and Second Red Bed.
Location: Cons Morrison Colonsay 5 33 34 27 (5-33-34-27W2). 3284 ft (1001 m).

Plate 3(2): Core.

Transition between bedded white and grey anhydrite (probably residue of the Prairie Evaporite) and dolomitic mudstone of the Second Red Bed. Probably the esult of solution of the Prairie salts and subsequent collapse, disruption, and brecciation of overlying strata.

Member: Contact of the Prairie Evaporite and Second Red Bed.
Location: C. M. and S. Asquith 1 4 37 10 (Lsd. 1-4-37-10W3). 3738 ft (1139 m).

Plate 3(3): Core.

Diffuse contact between highly disturbed laminae of grey anhydrite and microbrecciated grey dolomitic mudstone containing anhydrite clasts. Anhydrite is probably the residue of the Prairie Evaporite after salt-solutioning and subsequent collapse of overlying strata.

Member: Contact of the Prairie Evaporite and Second Red Bed (the anhydrite could belong to the Winnipegosis Formation, but probably originates from strata interbedded with Prairie salts).
Location: Southwest No. 2 (Lsd. 16-32-36-4W3). 3592 ft (1095 m).

1

2

3

Plate 4 Upper Second Red Bed Member: Laminated and Brecciated Dolomicrites

Plate 4(1): Core.

Well consolidated laminated pale grey dolomitic mudstone comprising the uppermost few centimetres of the Second Red Bed Member. Minor erosional surface at 'a'; enterolithic layer of anhydrite at 'b'; increase in argillaceous and bituminous content toward the top of the section.

Member: Second Red Bed.
Location: Kennco Prudhomme 3 27 38 27 (Lsd. 3-27-38-27W2). 3125 ft (953 m).

Plate 4(2): Core.

Well consolidated laminated pale grey dolomitic mudstone comprising the uppermost few centimetres of the Second Red Bed Member. Parallel laminae exhibit three depositional cycles (central one-third of the photograph) cut by a small 60 degree reverse fault 'a' and a parallel smaller normal fault 'b'.

Member: Second Red Bed.
Location: Kerr-McGee Horseshoe 16 36 30 28 (Lsd. 16-36-30-28W2). 3802 ft (1159 m).

Plate 4(3): Core.

Intraformational microbreccia of grey dolomitic mudstone near the top of the Second Red Bed Member. Lower portion is poorly consolidated.

Member: Second Red Bed.
Location: Duval Aberdeen 3 30 37 2 (Lsd. 3-30-37-2W3). 3183 ft (970 m).

Plate 4(4): Photomicrograph, crossed nicols. (Upper part of core shown on Plate 4(2)).

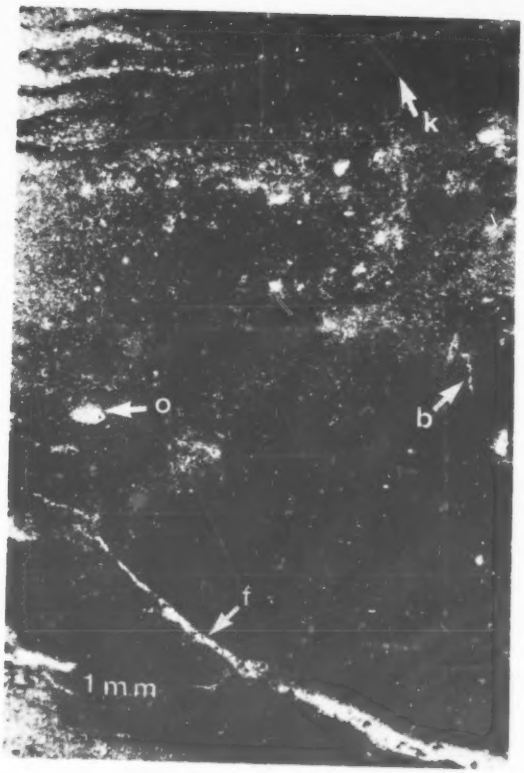
Uppermost strata of the Second Red Bed Member. Very fine-grained dolomite ($<2\mu m$) with thin kerogenous laminae 'k'; silicified ostracod tests 'o'; silica-filled borings 'b'; and silica filling a fracture 'f'. Dark streaks in lower part of photograph are pyrite.

Member: Second Red Bed.
Location: Kerr-McGee Horseshoe 16 36 30 28 (Lsd. 16-36-30-28W2). 3802 ft (1159 m).

1

2

3



4

Plate 5 Lower Burr Member: Laminated and Bioturbated Carbonates

Plate 5(1): Core.

Laminated bituminous limestone (dolomite at the base) comprising the basal portion of the Burr Member. Lowermost 4 cm is an oil-shale with carbonate laminae; organic content decreases upward. Note the change in dip of the strata from 25 degrees at the base to near horizontal 20 cm up the sequence.

Member: Burr (basal).
Location: Duval Aberdeen 3 30 37 2 (Lsd. 3-30-37-2W3). 3182 ft (970 m).

Plate 5(2): Photomicrograph, crossed nicols. Detail of lower part of Plate 5(1). Dark lines are laminae of kerogen, interbedded with fine grained dolomite and rhombs of dolomite.

Plate 5(3): Photomicrograph, crossed nicols. Detail of upper part of Plate 5(1). Peloids ('pel') and superficial ooliths ('oo') surrounded by carbonate rhombs. The rock is a limestone with some dolomite. (Black areas are holes in the slide).

Plate 5(4): Core.

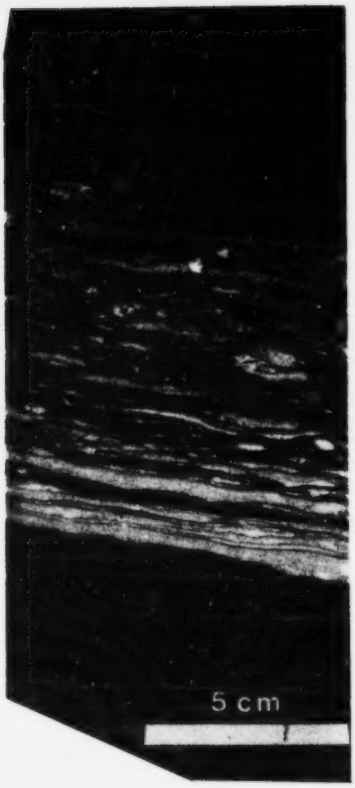
Bioturbated drab olive-brown microcrystalline limestone.

Member: Burr.
Location: Goldfield Grt Cdn. Dundurn 10 7 32 5 (Lsd. 10-7-32-5W3). 3686 ft (1123 m).

Plate 5(5): Core.

Drab medium-brown microsucrosic dolomitic limestone. Partial dolomitization has diffused the bioturbation and given rise to the mottled appearance.

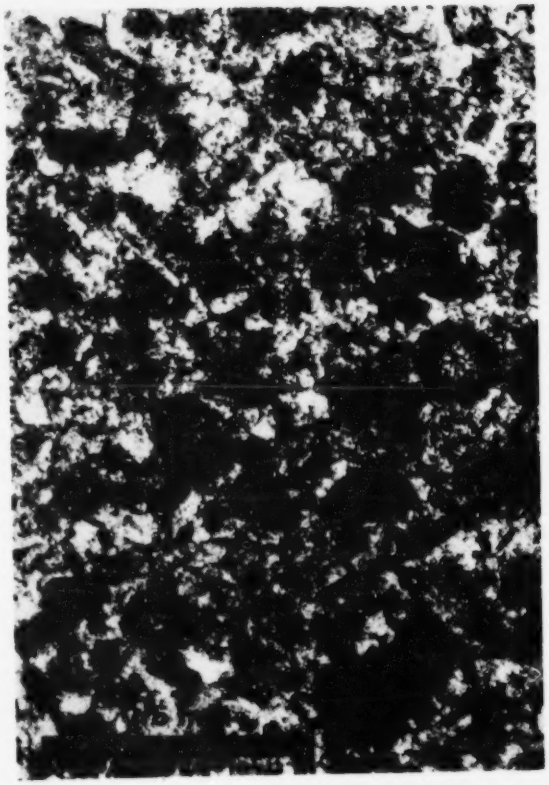
Member: Burr.
Location: General Petroleums Saskatoon 6 12 (Lsd. 6-12-38-4W3). 2946 ft (898 m).



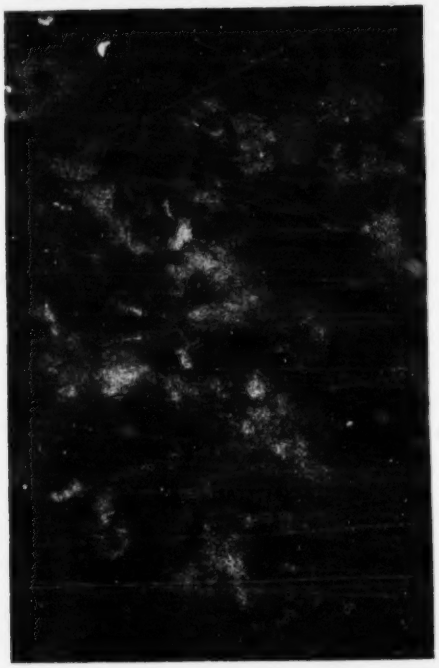
1

2

4



3



5

Plate 6 Burr Member: Detail of the Lower Dolomite, and Typical Hardgrounds of the Limestones

Plate 6(1): SEM photograph.

Microsucrosic to sucrosic dolomite composed of euhedral rhombs up to 15μm in diameter. The lithology is similar to that shown in Plate 5(5).

Member: Burr (lower).
Location: Kerr-McGee Horseshoe 16 36 30 28 (Lsd. 16-36-30-28W2). 3798 ft (1158 m).

Plate 6(2): Core.

Hardground 'h' in limestone sequence. Below, the rock is grey, cryptocrystalline and competent, as indicated by the steep-angle fractures. Above, the limestone is buff, microcrystalline and insufficiently competent to transmit the fractures. Shell fragments are of brachiopods and crinoids. An abundance of fossil debris infills irregularities in the hardground surface. Faunal concentration above the hardground is relatively high but the assemblage is similar to that below.

Member: Burr (middle) — type section.
Location: Dominion Potash Burr No. 4 18 (Lsd. 4-18-35-23W2). 3112 ft (949 m).

Plate 6(3): Core.

Similar to Plate 6(2), except that lithoclasts 'L' (some with bleached rims) are more evident in this slab.

Member: Burr
Location: S W P Boulder Lake 5 15 30 23 (Lsd. 5-15-30-23W2). 3390 ft (1033 m).

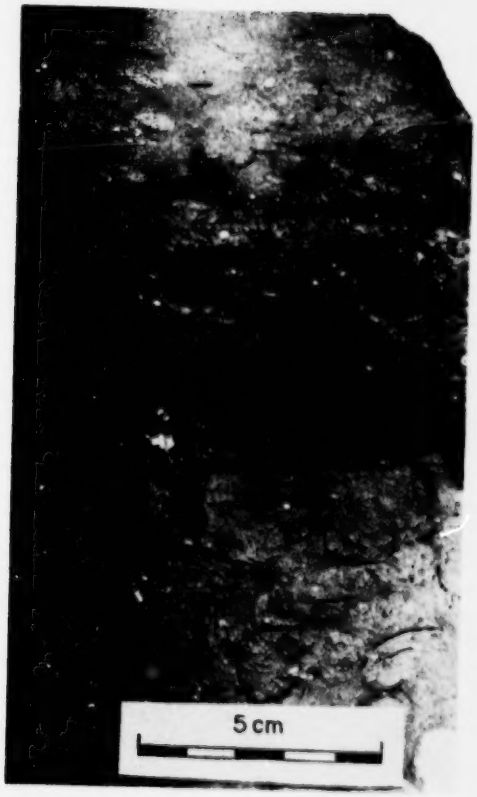
Plate 6(4): Photomicrograph, crossed nicols.

Detail of material contained within the burrow on the left-hand side of the hardground illustrated on Plate 6(3). Dark areas 'L' are micrite clasts; faunal debris includes brachiopods 'b', crinoids 'c', and a calcisphere 'ca'.

Member: Burr.
Location: S W P Boulder Lake 5 15 30 23 (Lsd. 5-15-30-23W2). 3390 ft (1033 m).

1

3



2

4

Plate 7 Burr Member: Poorly Defined Hardgrounds

Plate 7(1): Core.

Hardground 'h' in limestone. Mottling beneath the hardground was caused by bioturbation. Overlying fossiliferous limestone also contains lithoclasts 'L', some of which were washed down into burrows 'b'. Arrow on left indicates location of photomicrograph illustrated in Plate 7(2).

Member: Burr.
Location: Goldfield Grt Cdn. Dundurn 10 7 32 5 (Lsd. 10-7-32-5W3). 3660 ft (1116 m).

Plate 7 (2): Photomicrograph, crossed nicols.

Detail of region on left-central portion of Plate 7(1) (at arrow). Lithoclast 'L' is overlain by faunal debris which includes crinoids 'c', shell fragments 'b', and a calcisphere 'ca'. The lithoclast is slightly bituminous as evidenced by numerous flecks of orange kerogen seen through the microscope.

Member: Burr.
Location: Same as Plate 7(1).

Plate 7(3): Core.

Poorly-defined hardground 'h' in limestone. The characteristic black rind is faint, but there is a pronounced increase in fauna (mainly corals and brachiopods) above the surface. The more competent nature of the underlying sediment is evident from the vertical fracture.

Member: Burr.
Location: Kennco Prudhomme 3 27 38 27 (Lsd. 3-27-38-27W2). 3076 ft (938 m).

Plate 7(4): Core.

Similar to Plate 7(3), except no corals, and no black rind at the hardground 'h'. Mottling beneath the hardground is due to bioturbation.

Member: Burr.
Location: S W P Boulder Lake 5 15 30 23 (Lsd. 5-15-30-23W2). 3414 ft (1041 m).

1

2

3

4

Plate 8 Burr Member: Microscopic Detail of Lithologies Across Hardgrounds

Plate 8(1): SEM photograph.

Microcrystalline limestone just beneath the hardground illustrated in Plate 6(3). Displayed are two populations of grain size — 2-3μm and 10-15μm, which have been 'annealed' by cryptocrystalline carbonate cement draping over the grains.

Member: Burr.
Location: S W P Boulder Lake 5 15 30 23 (Lsd. 5-15-30-23W2). 3390 ft (1033 m).

Plate 8(2): SEM photograph.

Sample of microcrystalline limestone which occurs a few mm above that illustrated in Plate 8(1) — i.e. just above a hardground. The lithology appears identical to the above, except for the lack of 'annealing' cement, hence greater porosity and permeability.

Member: Burr.
Location: Same as Plates 6(3) and 8(1).

Plate 8(3): Photomicrograph, crossed nicols.

Microcrystalline limestone showing the darkened rind of a hardground above which there are abundant brachiopod fragments.

Member: Burr.
Location: S W P Boulder Lake 5 15 30 23 (Lsd. 5-15-30-23W2). 3418 ft (1042 m).

Plate 8(4): Photomicrograph, crossed nicols.

Detail of Plate 8(3) showing an apparent greater abundance of fine-grained carbonate below than above the hardground, although this may be due to the lower sediment being coated with cryptocrystalline carbonate cement [cf. Plates 8(1) and 8(2)].

1

2

3

4

Plate 9 Burr Member: Partial Dolomitization

Plate 9(1): Core.

Drab brown, sucrosic dolomitic limestone, etched with acid to bring out the calcareous (white) areas from the dolomitic (grey) areas. Note that anhydrite needles 'a' are restricted to the calcareous areas, and pyrite networks 'py' to the dolomite.

Member: Burr.
Location: Cdn. Expl. Langham A1 2 39 8 (Lsd. 1-2-39-8W3). 2990 ft (911 m).

Plate 9(2): Photomicrograph, crossed nicols.

Part of slab illustrated on Plate 9(1). This shows abundant rhombs of dolomite (about 100μm dia.) on the right half of the photograph, and scattered dolomite rhombs set in a calcareous micrite (dark) to the left. Anhydrite laths 'a' are seen confined to the micrite.

Plate 9(3): Core.

Pale brown microcrystalline limestone, partially dolomitized. The paler, fossiliferous areas are limestone, whereas the darker areas are dolomite. Note the absence of fossils in the dolomitic areas. Fossils include brachiopods 'b' and bryozoans 'bry'.

Member: Burr.
Location: W. James Donovan 16 34 32 8 (Lsd. 16-34-32-8W3). 3710 ft (1131 m).

Plate 9(4): Photomicrograph, crossed nicols.

Part of slab illustrated in Plate 9(3). Fossil shell infilled with micrite and fossil debris, and surrounded by rhombs of dolomite. The closed shell valves have protected the internal sediment from dolomitization.

1

2

3

4

Plate 10 Neely Member: Fossiliferous Carbonates

Plate 10(1): SEM photograph.

Slightly argillaceous microcrystalline limestone at the base of the Neely Member. The grain size is bimodal (2-3μm and 10-15μm) and is similar to lithologies which occur above hardgrounds of the Burr Member [cf. Pl. 8(2)], except for the presence here of small amounts of clay minerals.

Member: Neely — type section.
Location: Noranda Neely 16 21 34 27 (Lsd. 16-21-34-27W2). 3240 ft (988 m).

Plate 10(2): Core.

Medium brown cryptocrystalline limestone, with darker brown wispy bituminous laminae set in microcrystalline limestone bands 2-4 cm wide. The latter are slightly dolomitic. Small vugs 'v' and fractures 'f' are plugged with halite and are confined to the more competent limestone. Conversely the faunal fragments (predominantly ossicles of the crinoid *Gasterocoma*) are concentrated in the more porous zones.

Member: Neely.
Location: Duval Potash Saskatoon 6 18 36 6 (Lsd. 6-18-36-6W3). 3182 ft (970 m).

Plate 10(3): Core.

Medium brown microcrystalline limestone with bituminous wisps. Fossils present include stromatoporoids 's', bryozoans 'b' and the large thin-shelled brachiopod *Stringocephalus* 'st'.

Member: Neely.
Location: Dominion Potash Burr No. 4 18 (Lsd. 4-18-35-23W2). 3040 ft (927 m).

Plate 10(4): Core.

Large stromatoporoid 's' set in black bituminous microcrystalline limestone, containing abundant vugs which are plugged with halite 'h'.

Member: Neely — type section.
Location: Noranda Neely 16 21 34 27 (Lsd. 16-21-34-27W2). 3207 ft (977 m).

Plate 10(5): Core.

Medium brown, bituminous microcrystalline limestone containing stromatoporoids 's'. Small vugs are plugged with halite. Incipient stylolites 'st' are present.

Member: Neely.
Location: Kerr McGee Esk 8 20 33 20 (Lsd. 8-20-33-20W2). 2991 ft (912 m).

1

2

3

4

5

Plate 11 Neely Member: Microscopic Detail of Carbonates

Plate 11(1): Photomicrograph, crossed nicols.

Sucrosic dolomite, with patch of undolomitized laminated lime mud (dark area) adjacent to a coral 'c'.

Member: Neely.
Location: Kennco Prudhomme 3 27 38 27 (Lsd. 3-27-38-27W2). 3042 ft (927 m).

Plate 11(2): Photomicrograph, crossed nicols.

Detail of Plate 11(1) showing dolomite rhombs up to 100μm across, locally encroaching upon a fragment of brachiopod shell 'b'.

Plate 11(3): SEM photograph.

Sucrosic limestone containing rhombs of calcite up to 80μm across.

Member: Neely.
Location: Duval Potash Saskatoon 1 11 37 7 (Lsd. 1-11-37-7W3). 3121 ft (951 m).

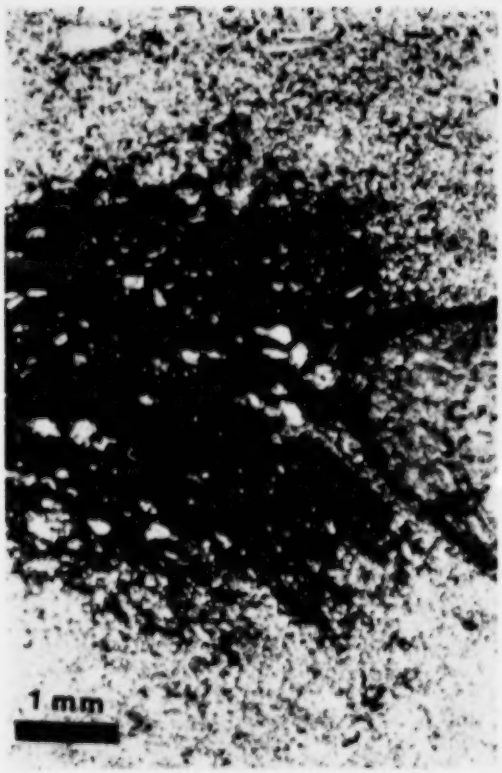
Plate 11(4): SEM photograph.

Detail of Plate 11(3) showing two sizes of calcite crystals – 50 to 80μm and 3 to 5 μm. Poor cementation of the crystals gives rise to high porosity and permeability.

Plate 11(5): SEM photograph.

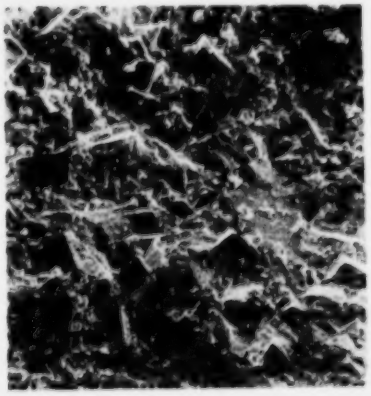
Sucrosic limestone (partially dolomitized) typical of the middle part of the Neely Member: crystal sizes up to 50μm. Small vugs.

Member: Neely.
Location: Kerr McGee Esk 8 20 33 20 (Lsd. 8-20-33-20W2). 3021 ft (921 m).

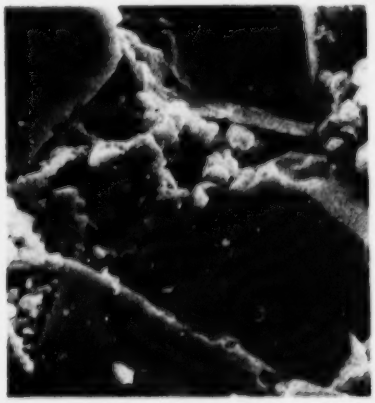


1

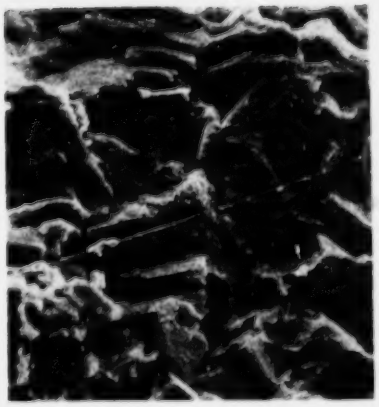
2



3



4



5

Plate 12 Upper Neely Member: Photomicrographs of Pelleted Carbonates

Plate 12(1): Photomicrograph, crossed nicols.

Limestone composed of micrite pellets 'pel' with scattered rhombs (20-50μm) of dolomite. Good vuggy porosity 'por' is plugged with halite. Light object on the right is a spherule of chalcedony. Dark lamina 'L' contains wisps of kerogen.

Member: Neely (upper).
Location: S W P Boulder Lake 5 15 30 23 (Lsd. 5-15-30-23W2). 3342 ft (1019 m).

Plate 12(2): Photomicrograph, crossed nicols.

Felted fibres of anhydrite (white) interbedded and intermixed with pelleted bituminous dolomite (black). Occasional bituminous wisps within the anhydrite. Vertical crack 'a' is infilled with relatively large crystals of anhydrite, and is probably a desiccation crack.

Member: Neely (upper).
Location: Kennco Prudhomme 3 27 38 27 (Lsd. 3-27-38-27W2). 3023 ft (921 m).

Plate 12(3): Photomicrograph, crossed nicols.

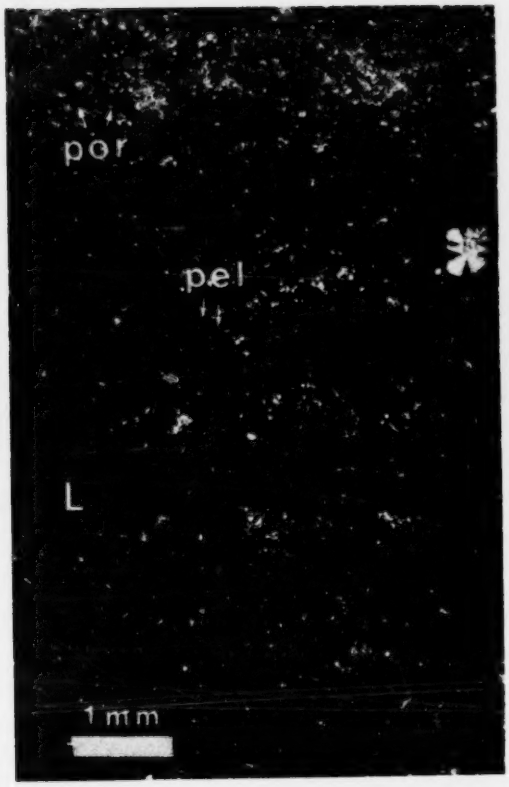
Dolomitized biopelmicrite with minor felted fibres of anhydrite. Vestiges of ostracods? 'o'. Bituminous wisps.

Member: Neely (upper).
Location: Alwinsal Loyola 4 32 (Lsd. 4-32-34-21W2). 2876 ft (877 m).

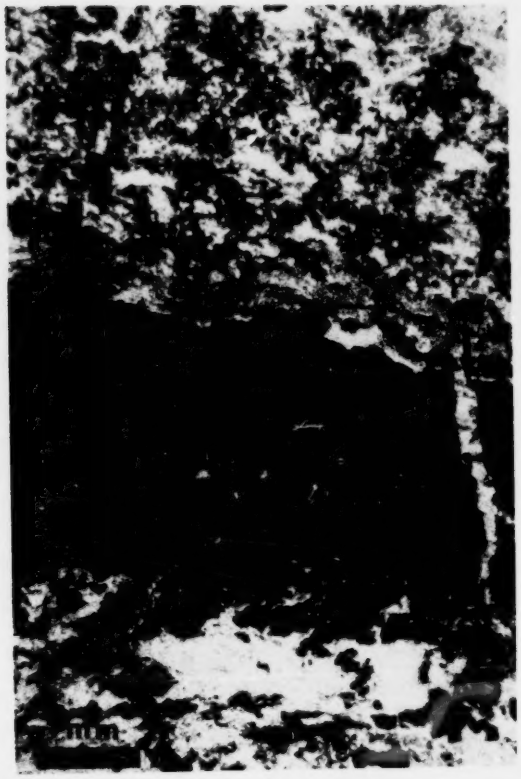
Plate 12(4): Photomicrograph, crossed nicols.

Bituminous biosparite containing ostracods 'o' and brachiopod (?) shell fragments 'b' with scattered pellets. Abundant bituminous material.

Member: Neely (upper).
Location: Kerr McGee Esk 8 20 33 20 (Lsd. 8-20-33-20W2). 2991 ft (912 m).



1



2

3

4

Plate 13 Upper Neely Member: Bituminous Carbonates

Plate 13(1): Core.

Microcrystalline bituminous limestone containing gastropods 'g' and stromatoporoids 's'.

Member: Neely (upper.)
Location: Dominion Potash Burr No. 4 18 (Lsd. 4-18-35-23W2). 3040 ft (927 m).

Plate 13(2): Core.

Microcrystalline bituminous limestone containing restricted fauna of dwarf gastropods (at arrows) which are infilled with bituminous halite.

Member: Neely (upper).
Location: Imperial Guernsey 13 34 33 23 (Lsd. 13-34-33-23W2). 3109 ft (948 m).

Plate 13(3): Core.

Algal stromatolite 's' with microcrystalline bituminous calcareous dolomite 'c'. Large vugs are plugged with transparent halite 'h'. Anhydrite needles 'a' have grown in the stromatolite.

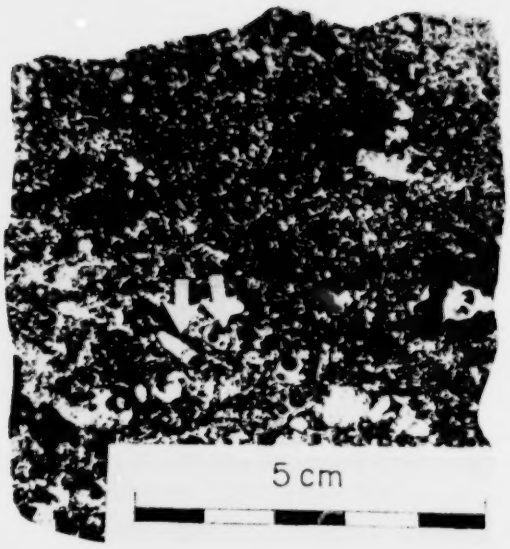
Member: Neely (upper).
Location: Duval Saskatoon 6 18 36 6 (Lsd. 6-18-36-6W3). 3177 ft (968 m).

Plate 13(4): Core.

Microcrystalline bituminous limestone. Vugs lined with white calcite and infilled with transparent halite.

Member: Neely (upper).
Location: Continental Potash Arelee 7 4 38 11 (Lsd. 7-4-38-11W3). 3416 ft (1041 m).

1



2

3

4

Plate 14 Upper Neely Member: SEM Photographs of Bituminous Carbonate; also Algal Growths

Plate 14(1): SEM photograph.

Detail of Plate 13(2): calcite crystals 'c' with globular bituminous material 'b'.

Plate 14(2): SEM photograph.

Close-up of 'b' on Plate 14(1) to illustrate the reniform texture of the bituminous material.

Plate 14(3): Core.

Algal stromatolite (dolomitic) with interstitial anhydrite, overlain by interbedded and intermixed dolomite and anhydrite.

Member: Neely (upper).
Location: S W P Boulder Lake 5 15 30 23 (Lsd. 5-15-30-23W2). 3335 ft (1017 m).

Plate 14(4): Core.

Dolomitic algal mats with interbedded pellets. Porosity is plugged with halite. Anhydrite needles 'a' in lower part of slab.

Member: Neely (upper).
Location: Imperial Guernsey 13 34 33 23 (Lsd. 13-34-33-23W2). 3108 ft (947 m).

1

2

3

4

Plate 15 Upper Neely Member: Interbedded Dolomite and Anhydrite

Plate 15(1): Core.

Laminae of dolomite (algal mats?) interbedded with anhydrite, and overlain by convolute bedded anhydrite at top of photograph.

Member: Neely (upper).
Location: Alwinsal Loyola 4 32 34 21 (Lsd. 4-32-34-21W2). 2876 ft (877 m).

Plate 15(2): Core.

Laminae of dolomite (algal mats?) interbedded with anhydrite, and overlain by contorted intimate mixture of buff dolomite and bluish anhydrite.

Member: Neely (upper).
Location: Kennco Prudhomme 3 27 38 27 (Lsd. 3-27-38-27W2). 3023 ft (921 m).

Plate 15(3): SEM photograph.

Detail of lower part of plate 15(2) showing rhombic crystals of dolomite ranging in size from a few microns to 50μm.

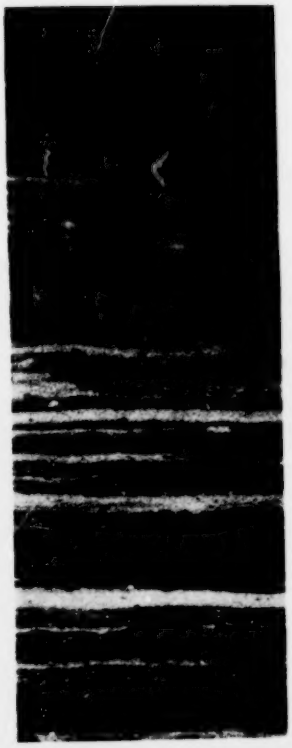
Plate 15(4): Photomicrograph, crossed nicols.

Detail of anhydritic central portion of Plate 15(2) showing ptygmatic band of dolomite (black), which was once a pelmicrite, set in a matrix of fine fibres of anhydrite. Traces of kerogen.

Plate 15(5): Photomicrograph, crossed nicols.

Interbedded cryptocrystalline dolomite (black) with very fine grained fibres ($< 2\mu$m) of anhydrite. Traces of pellets suggest that the sediment originated as a pelmicrite. There are traces of kerogen.

Member: Neely (upper).
Location: Goldfield Grt Cdn Dundurn 10 7 32 5 (Lsd. 10-7-32-5W3). 3598 ft (1097 m).



1

2

3

4

5

Plate 16 Upper Neely Member: Anhydrite

Plate 16(1): Core.

Bluish and white, bedded and nodular anhydrite intermixed with minor amounts of buff cryptocrystalline dolomite.

Member: Neely (upper), immediately below marginal facies of the Hubbard Evaporite.
Location: Kerr McGee Esk 8 20 33 20 (Lsd. 8-20-33-20W2). 2982 ft (909 m).

Plate 16(2): Core.

Bluish-grey nodular anhydrite 'a' interbedded with sucrosic pale-brown dolomite 'd'-algal? Halite 'h' plugs pores in the dolomite and vugs in both dolomite and anhydrite.

Member: Neely.
Location: Imperial Guernsey 13 34 33 23 (Lsd. 13-34-33-23W2). 3105 ft (946 m).

Plate 16(3): SEM photograph.

Felted fibres of anhydrite showing the dense packing and absence of porosity.

Member: Neely (upper).
Location: Duval Potash Saskatoon 1 11 37 7 (Lsd. 1-11-37-7W3). 3114 ft (949 m).

Plate 16(4): SEM photograph.

Detail of Plate 16(3) to show fractures and cleavage.

1

2

3

4

Plate 17 Halite in the Upper Neely Member and Hubbard Evaporite

Plate 17(1): Core.

Dark bluish-grey anhydrite 'a' overlying greenish-grey dolomitic mudstone 'd' which contains a 5 cm band of orange fibrous halite 'h'. The dolomitic mudstone has been forced apart by the secondary halite growth so that clasts of mudstone 'cl' appear to 'float' within the halite.

Member: Neely (upper)
Location: S W P Boulder Lake 5 15 30 23 (Lsd. 5-15-30-23W2). 3332 ft (1016 m).

Plate 17(2): Photomicrograph, nicols partially crossed.

Laminated fibrous anhydrite 'a' mixed with cryptocrystalline bituminous dolomite 'd' overlain by halite 'h' which has prised apart the anhydrite laminae. White areas are inclusions of fibrous anhydrite. Partially crossed nicols serve to emphasize cleavage and fractures in the halite.

Member: Hubbard (basal).
Location: KR et al Nokomis 8 7 30 20 (Lsd. 8-7-30-20W2). 3281 ft (1000 m).

Plate 17(3): Core.

Medium grey dolomitic mudstone wedged apart by secondary brownish halite 'h'.

Member: Neely (upper).
Location: Alwinsal Mohawk 1 10 (Lsd. 1-10-33-24W2). 3160 ft (963 m).

Plate 17(4): Core.

Microcrystalline medium brown limestone containing stromatoporoids 's'. Core is riddled with fractures caused by, and filled with halite (dark grey areas). Large chevron crystal of halite 'h'.

Member: Neely (type section).
Location: Noranda Neely 16 21 34 27 (Lsd. 16-21-34-27W2). 3207 ft (977 m).

1

2

3

4

Plate 18 Upper Neely Member: Porosity and Fossils Plugged with Halite and Gypsum

Plate 18(1): Photomicrograph, nicols crossed.

Algal dolomite, showing cellular structure and vugs 'v', which are lined with small rhombs of dolomite and infilled with halite.

Member: Neely (upper.)
Location: Kennco 2-Young 15 36 32 29 (Lsd. 15-36-32-29W2). 3494 ft (1065 m).

Plate 18(2): Core.

Microsucrosic grey dolomite with gastropod shell that has been replaced completely by halite.

Member: Neely.
Location: Kerr McGee Esk 8 20 33 20 (Lsd. 8-20-33-20W2). 2991 ft (912 m).

Plate 18(3): Core.

Microcrystalline black bituminous limestone containing dwarf gastropods 'g' infilled with halite. Halite stringers 'h' present.

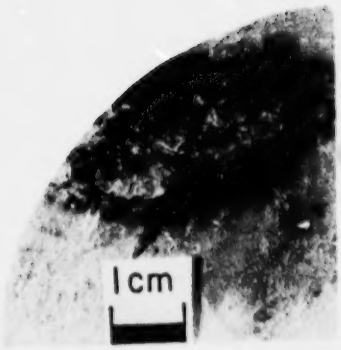
Member: Neely (type section).
Location: Noranda Neely 16 21 34 27 (Lsd. 16-21-34-27W2). 3193 ft (973 m).

Plate 18(4): Core.

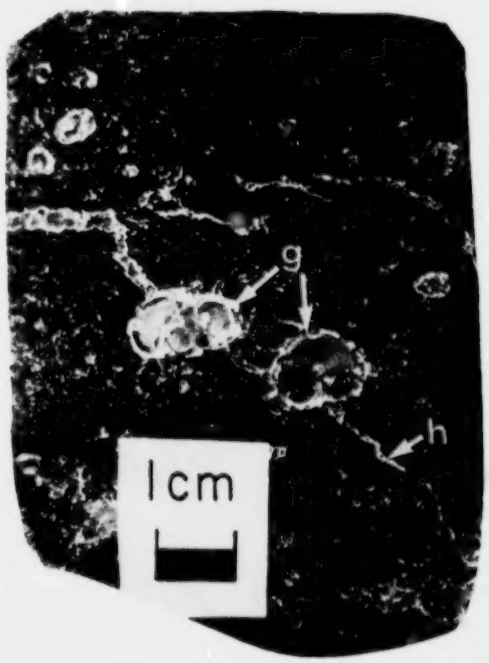
Medium drab brown microsucrosic dolomite. Vugs 'v' are lined with sucrosic pale brown dolomite, and infilled with transparent gypsum. Black networks are pyrite 'py' probably after anhydrite.

Member: Neely.
Location: Ceepee Riley Lake 3 4 (Lsd. 3-4-39-13W3). 3814 ft (1163 m).

1



2



3

4

Plate 19 Microkarst Feature (1), and Fractures Plugged with Halite

Plate 19(1): Core.

Mixture of carbonate and anhydrite fragments filling a void in laminated bituminous limestone 'L'. Probably a microkarst feature (see text).

Member: Neely (type section).
Location: Noranda Neely 16 21 34 27 (Lsd. 16-21-34-27W2). 3203 ft (976 m).

Plate 19(2): Core.

Microcrystalline limestone with near vertical fractures plugged with halite.

Member: Burr (upper).
Location: C.M. and S. Vanscoy 4 18 35 8 (Lsd. 4-18-35-8W3). 3467 ft (1057 m).

Plate 19(3): Core.

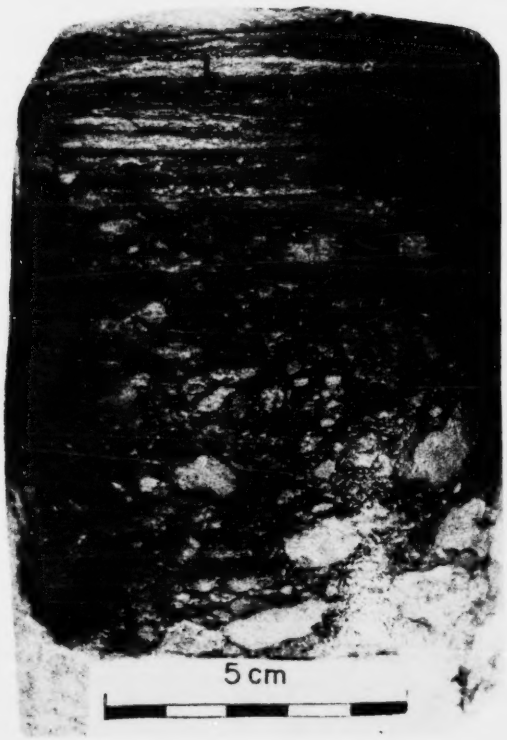
Small normal fault across hardground 'h' in microcrystalline limestone, which has subsequently been wedged apart and infilled by halite.

Member: Burr (upper).
Location: C.M. and S. Vanscoy 4 18 35 8 (Lsd. 4-18-35-8W3). 3463 ft (1056 m).

Plate 19(4): Core.

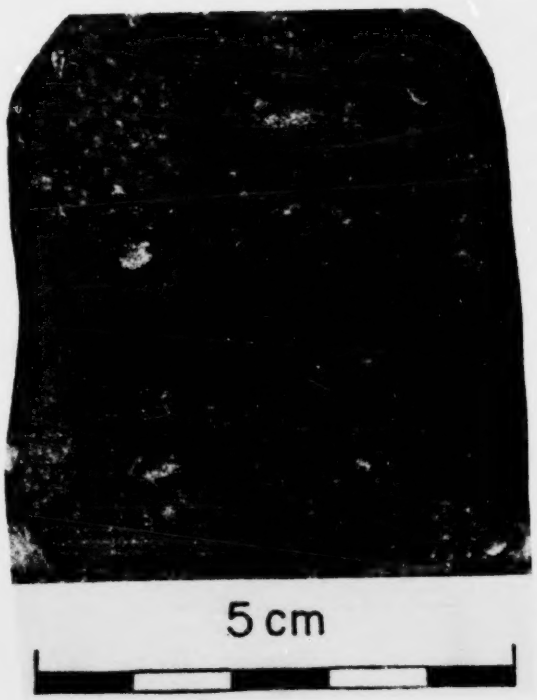
Fracture in microcrystalline limestone cutting through, and displacing a coral 'c'. Fracture is filled with halite.

Member: Burr.
Location: C.M. and S. Vanscoy 4 18 35 8 (Lsd. 4-18-35-8W3). 3464 ft (1056 m).



1

2



3

4

Plate 20 Microscopic Detail of Fractures and Cracks

Plate 20(1): Photomicrograph, nicols partially crossed.

Hairline cracks in halite (dark grey), which terminate at the junction with laminated fibrous anhydrite (white).

Member: Hubbard.
Location: KR et al Nokomis 8 7 30 20 (Lsd. 8-7-30-20W2). 3281 ft (1000 m).

Plate 20(2): Photomicrograph, crossed nicols.

Pelleted bituminous dolomite (dark grey) with felted fibres of anhydrite (white). Several fractures 'f' in the dolomite near the top of the section are probably desiccation cracks.

Member: Neely.
Location: Kennco Prudhomme 3 27 38 27 (Lsd. 3-27-38-27W2). 3024 ft (922 m).

1

2

Plate 21 Results of Solution Collapse

Plate 21(1): Core.

Solution breccia of Dawson Bay carbonate fragments set in a matrix of red dolomitic mudstone.

Member: Probably Second Red Bed with fragments of Burr Member carbonates.
Location: Imperial Fortune 13 20 30 14 (Lsd. 13-20-30-14W3). 4658 ft (1420 m).

Plate 21(2): Core.

Upper contact of fallen block of microsucrosic buff dolomite of the Burr Member lying *beneath* a mixture of brecciated dolomitic mudstone and halite of the Prairie Evaporite. The block occurs 159 ft (48 m) beneath the top of the Prairie Evaporite. Vertical drill-hole: angle of contact is 50°. The carbonate has an irregular, fractured surface with no sign of weathering or erosion.

Member: Burr (within Prairie Evaporite).
Location: C.M. and S. Vanscoy 4 30 35 8 (Lsd. 4-30-35-8W3). 3701 ft (1128 m).

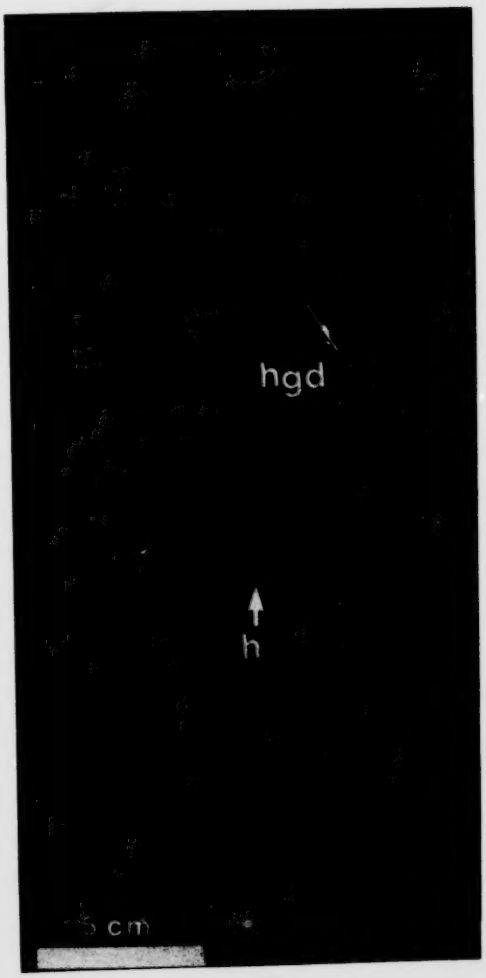
Plate 21(3): Core.

Hardground 'hgd' dipping at 65° within the fallen block described in Plate 21(2). Buff, bioturbated, microsucrosic dolomitic limestone is overlain by wispy-laminated bituminous limestone. Some halite-filled vugs 'h' and a few blebs of bluish anhydrite. Few crinoid ossicles.

Member: Burr (within Prairie Evaporite).
Location: C.M. and S. Vanscoy 4 30 35 8 (Lsd. 4-30-35-8W3). 3705 ft (1129 m).

1

2



3

A

51 km
32 mi

140 km
87 mi

180 km
112 mi

350 km
217 mi

240 km
149 mi

152 km
94 mi

1
SHELL SWAN HILLS 6-31
6-31-67-12 W5
KB 1326m 4351 ft
GR

2
HOME IMP. GRIZZLY MTN. 10-16
10-16-69-7 W5
KB 928m 3048 ft
GR

3
TRIAD CALLING L. 6-11
6-11-69-19 W4
KB 540m 1770 ft
GR

4
ANGLO CANADIAN ELK POINT 11
2-21-57-5 W4
KB 633m 2076 ft
GR

5
CPOG LEIPZIG 2-30
2-30-37-19 W3
KB 675m 2214 ft
GR

6
IMPERIAL GUERNSEY 13-34
13-34-33-23 W2
KB 546m 1791 ft
GR

GILWOOD S.S.

WATT MOUNTAIN FORMATION

GRIZZLY S.S.

UPPER ELK POINT GROUP

LOWER ELK POINT GROUP

BASAL DEVONIAN UNCONFORMITY

CAMBRIAN

SOURIS RIVER FORMATION

DAWSON BAY FORMATION

PRAIRIE EVAPORITE

WINNIPEGOSIS FORMATION

ASHERN FM.

INTERLAKE FORMATION (SILURIAN)

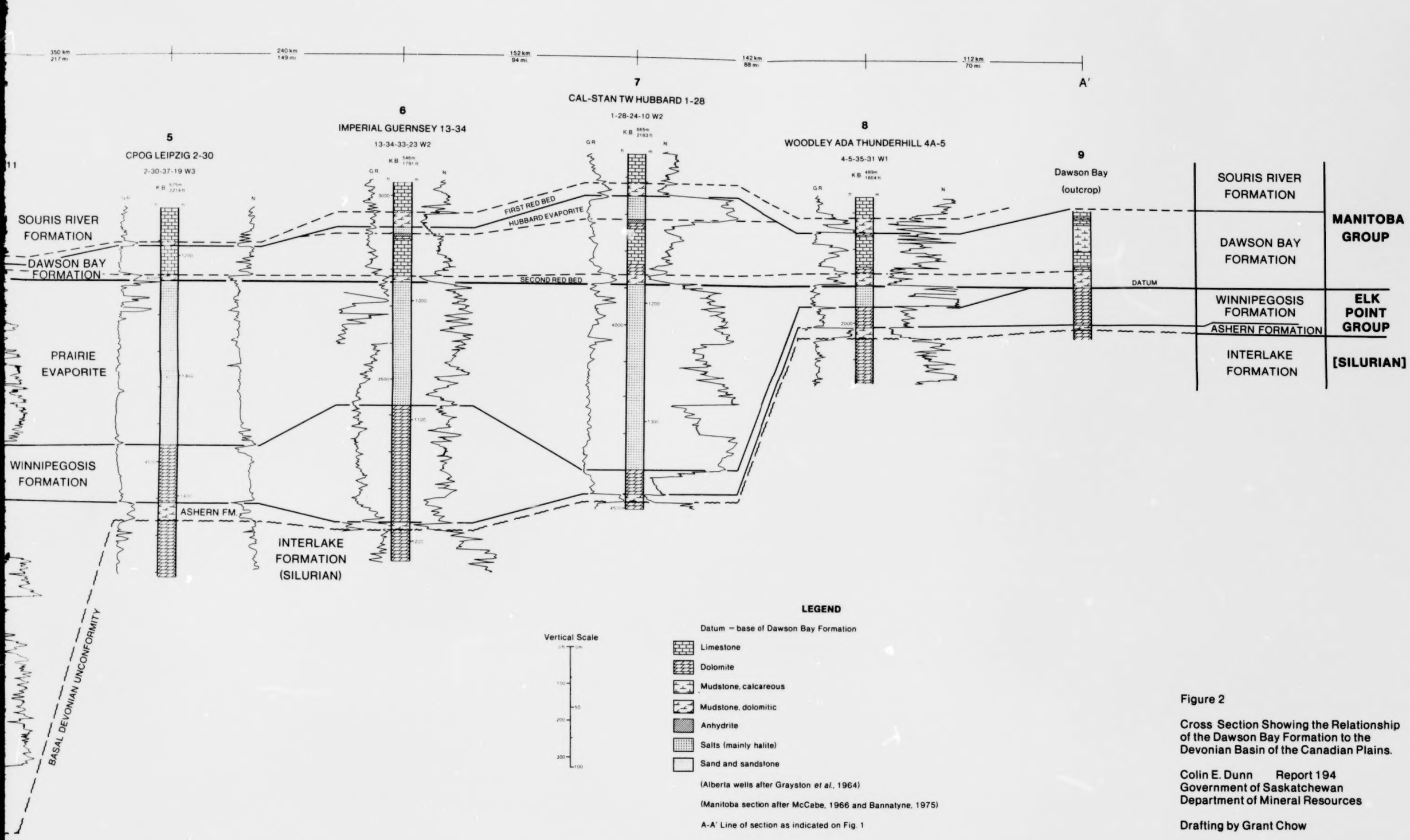
BASAL DEVONIAN UNCONFORMITY

FIRST RED BED

HUBBARD EVAPOR

SECOND RED B

Vertica



Vertical Scale

LEGEND

Datum = base of Dawson Bay Formation

- Limestone
- Dolomite
- Mudstone, calcareous
- Mudstone, dolomitic
- Anhydrite
- Salts (mainly halite)
- Sand and sandstone

(Alberta wells after Grayston *et al.*, 1964)

(Manitoba section after McCabe, 1966 and Bannatyne, 1975)

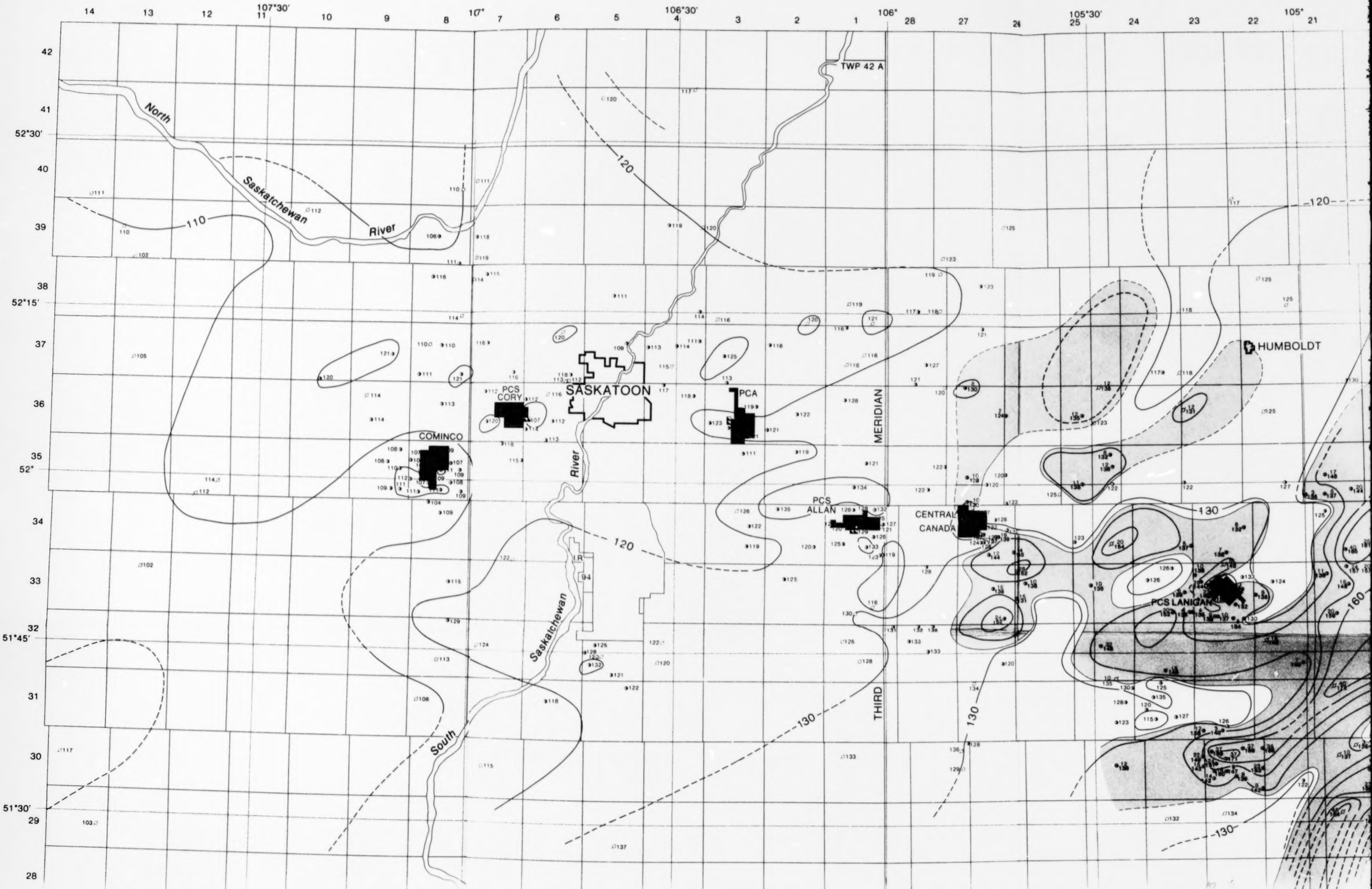
A-A' Line of section as indicated on Fig. 1

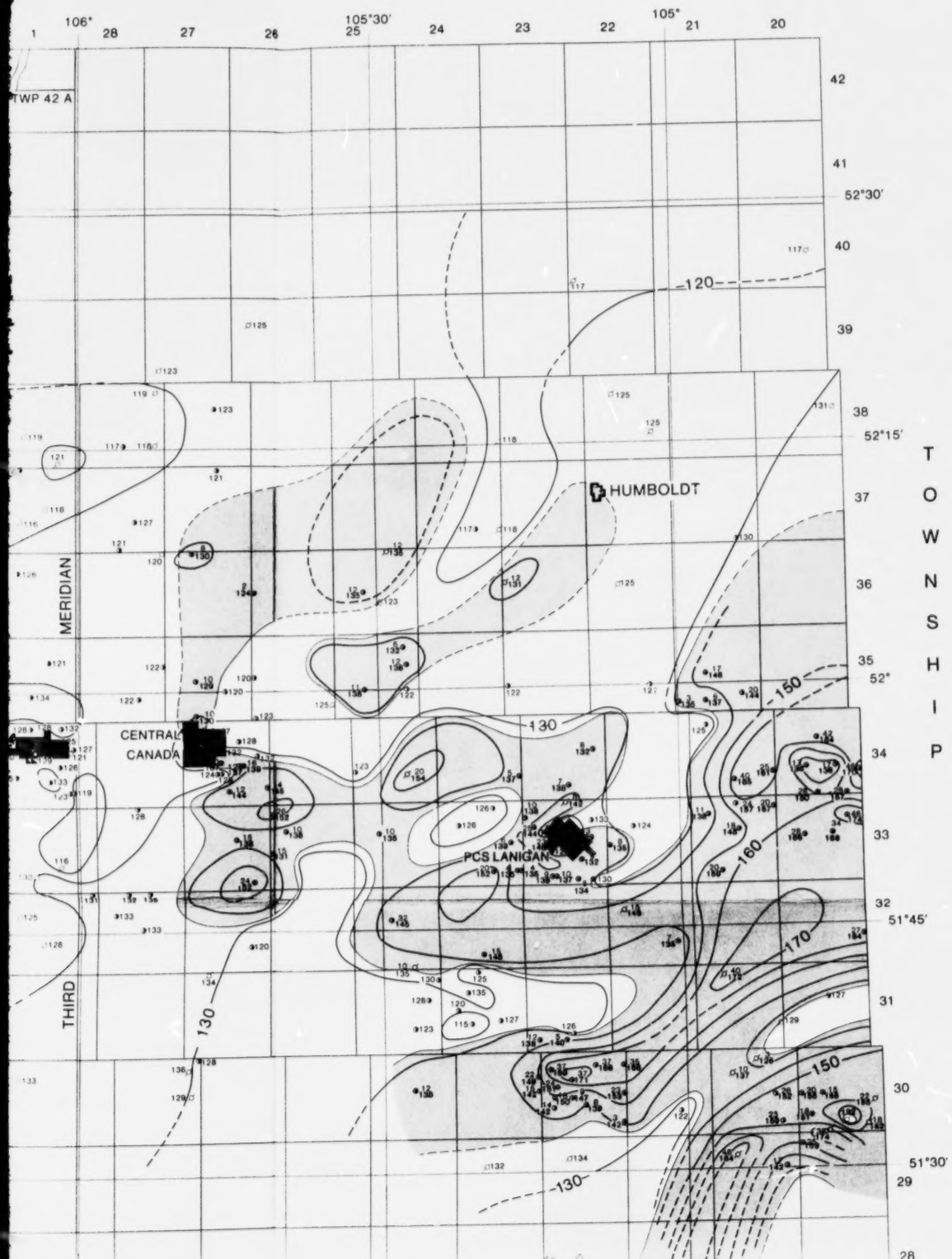
Figure 2

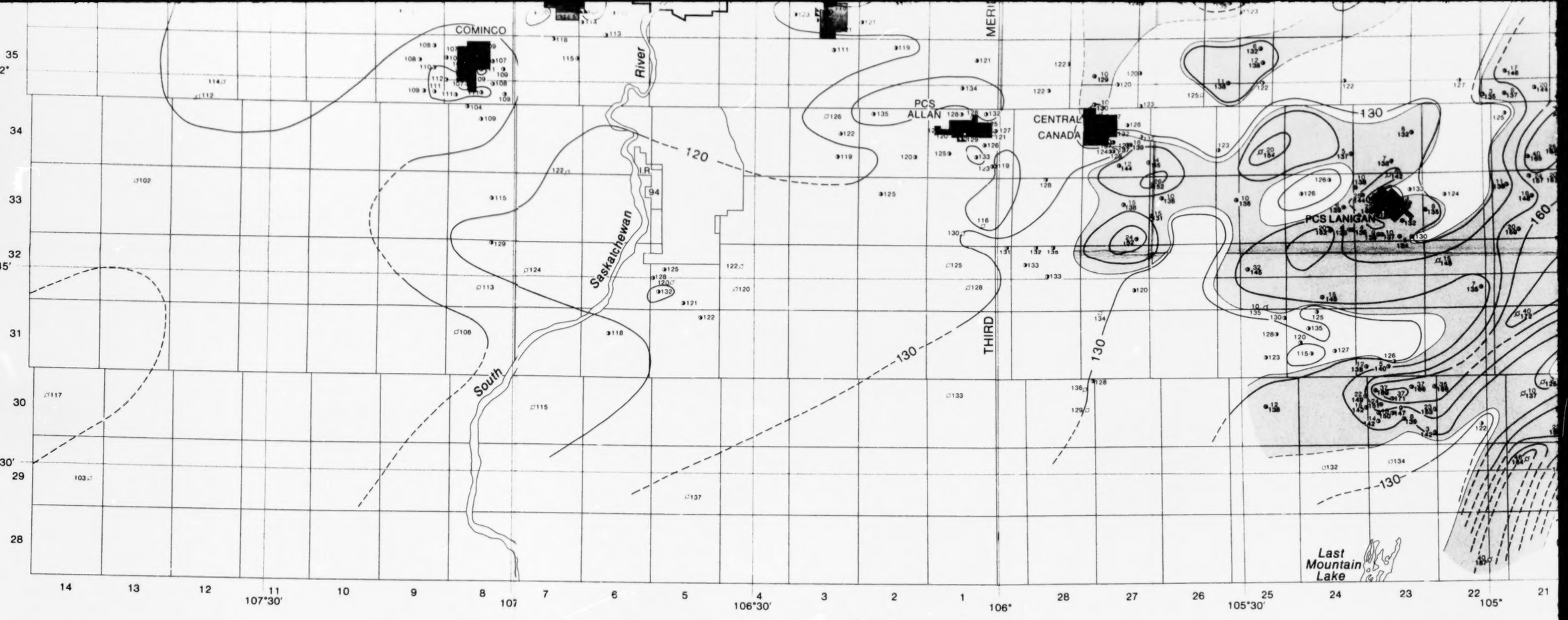
Cross Section Showing the Relationship of the Dawson Bay Formation to the Devonian Basin of the Canadian Plains.

Colin E. Dunn Report 194
Government of Saskatchewan
Department of Mineral Resources

Drafting by Grant Chow


107°30'
107°
106°30'
106°
105°30'
105°
52°30'
52°15'
52°
51°45'
51°30'
TWP 42 A
North
Saskatchewan
River
110
120
130
160
SASKATOON
PCS
CORY
COMINCO
PCA
HUMBOLDT
PCS
ALLAN
CENTRAL
CANADA
PCS LANIGAN
MERIDIAN
THIRD
IR
94
Saskatchewan
River
South


106°
105°30'
105°
1
28
27
26
25
24
23
22
21
20
42
41
52°30'
40
39
38
52°15'
37
36
35
52°
34
33
32
51°45'
31
30
51°30'
29
28
TWP 42 A
THIRD MERIDIAN
HUMBOLDT
CENTRAL CANADA
PCS LANIGAN
120
130
150
160
170
TOWNSHIP



LEGEND

Contour Interval = 10 feet (approx. 3 metres)

Well Symbols

- Potash test hole
- Disposal well
- Wildcat well
- Potash shaft hole

Potash mine — approximate extent of mining operations

Extent of Hubbard Evaporite with thickness in feet

Isopach Map of the Dawson Bay Formation

SCALE

Kilometres 12 0 12 24 36 Kilometres

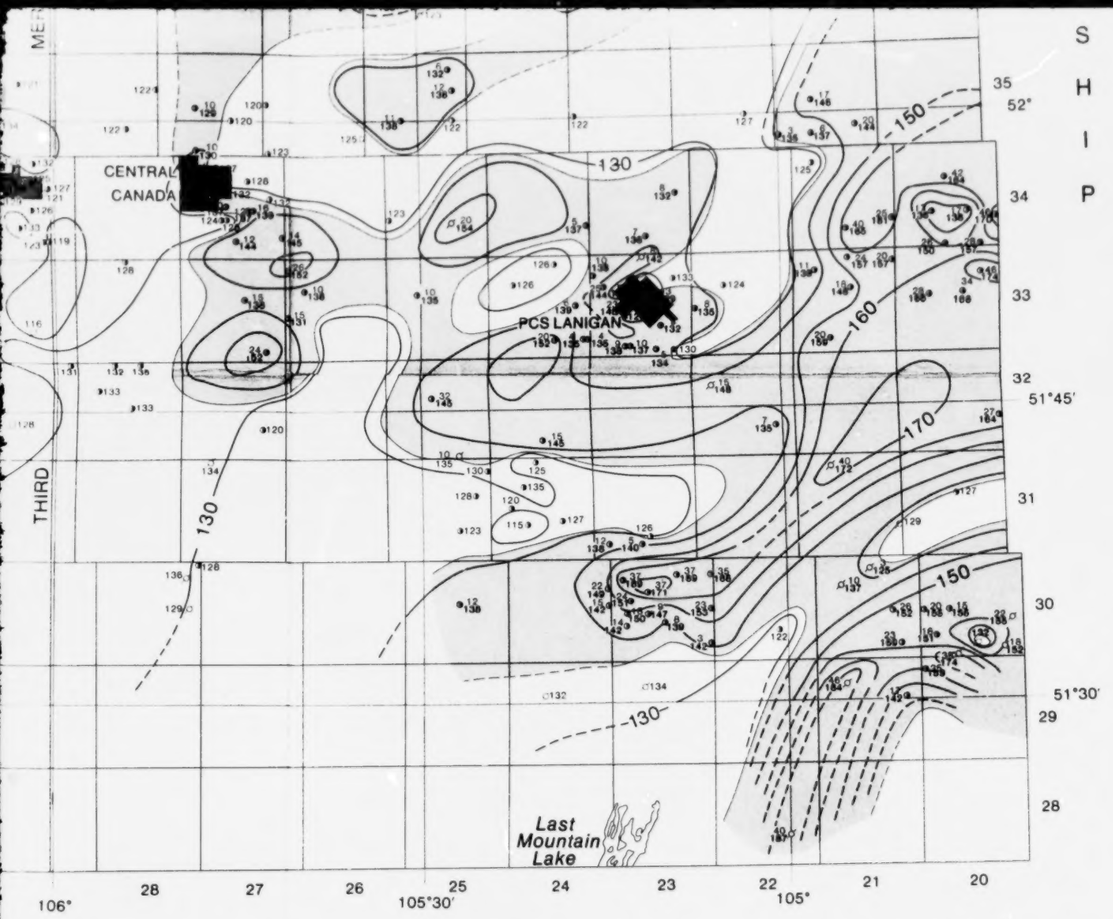
Miles 8 0 8 16 24 Miles

Figure 3

Isopach Map o
Dawson Bay Fo

Colin E. Dunn
Government of
Department of

Drafting by P. A



Bay Formation

36 Kilometres

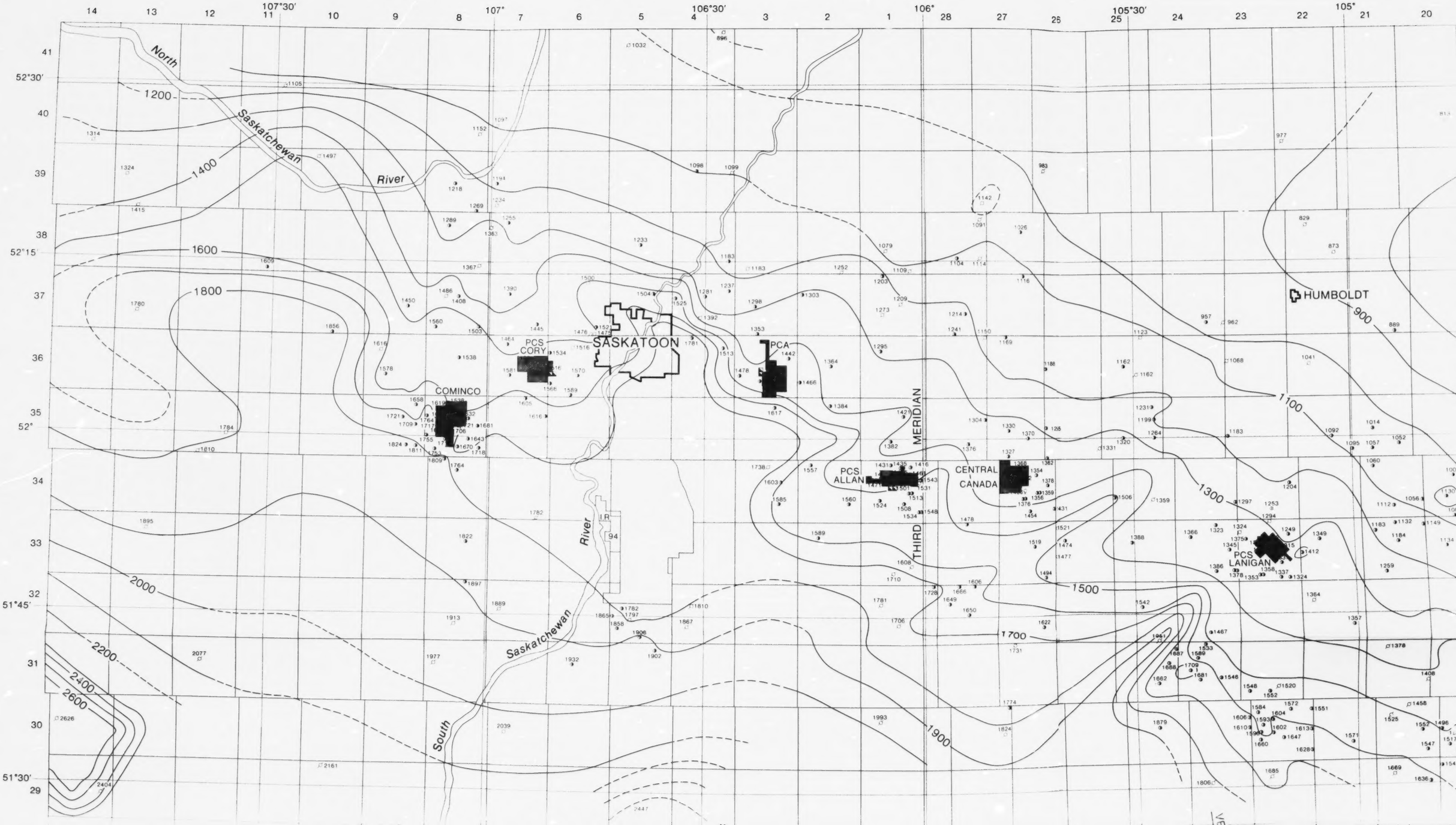
24 Miles

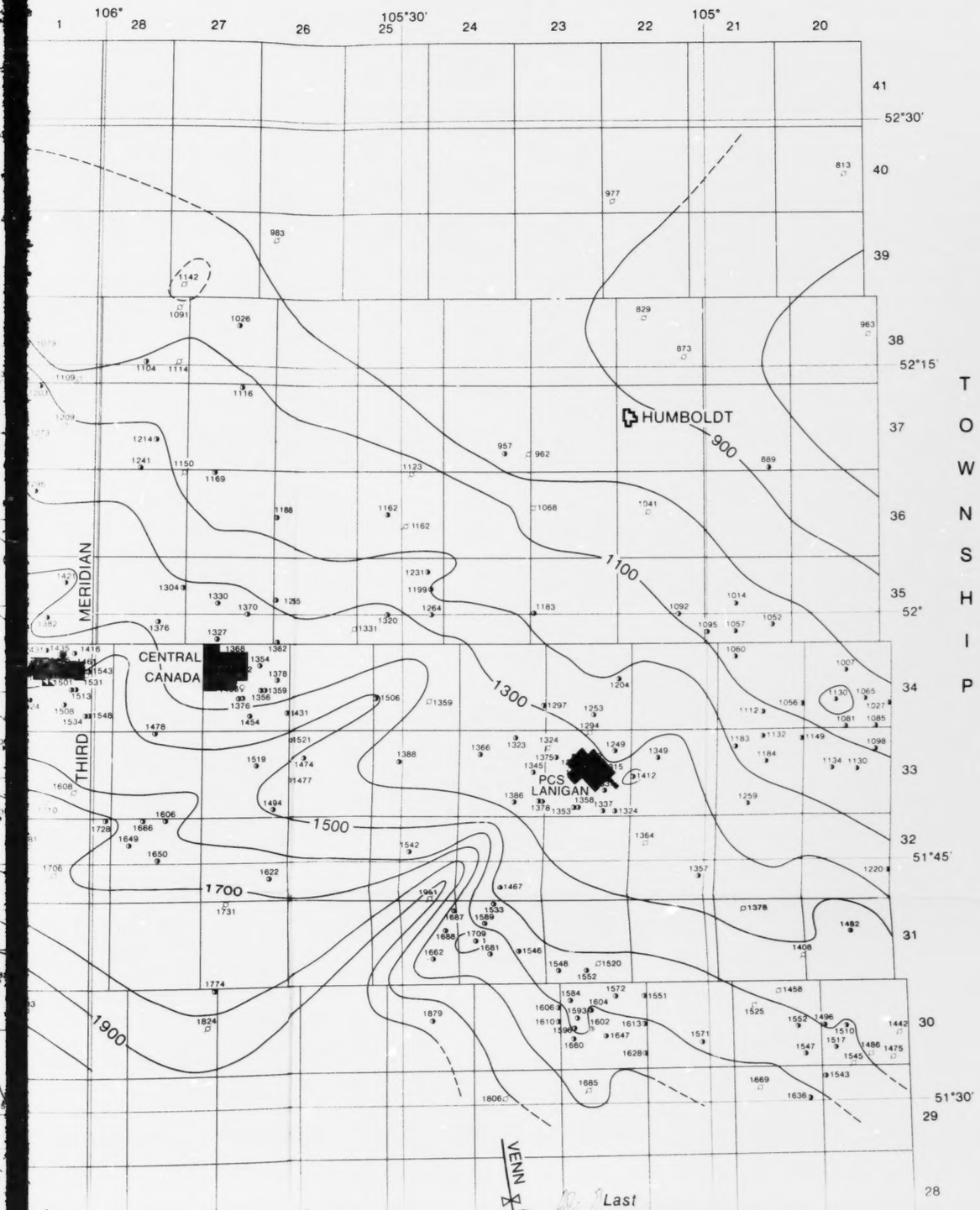
Figure 3

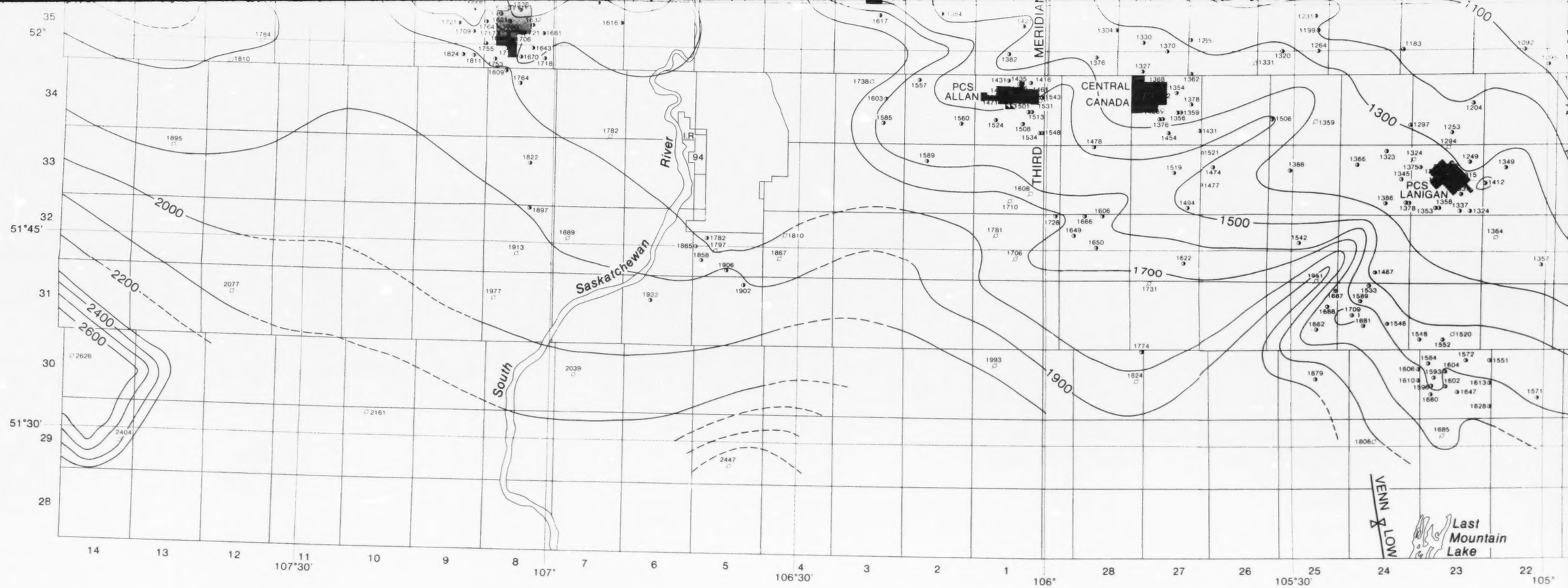
Isopach Map of the
Dawson Bay Formation

Colin E. Dunn Report 194
Government of Saskatchewan
Department of Mineral Resources

Drafting by P. A. Weir


107°30'
107°
106°30'
106°
105°30'
105°
52°30'
52°15'
52°
51°45'
51°30'
North
Saskatchewan
River
1200
1400
1600
1800
2000
2200
2400
2600
SASKATOON
PCS CORY
COMINCO
PCA
HUMBOLDT
PCS ALLAN
CENTRAL CANADA
PCS LANIGAN
THIRD MERIDIAN
IR 94
900
1100
1300
1500
1700
1900
South
Saskatchewan


106°
105°30'
105°
1
28
27
26
25
24
23
22
21
20
41
52°30'
40
39
38
52°15'
37
36
35
52°
34
33
32
51°45'
31
30
51°30'
29
28
THIRD MERIDIAN
TOWNSHIP
CENTRAL CANADA
HUMBOLDT
PCS LANIGAN
900
1100
1300
1500
1700
1900
VENN
Last



LEGEND

Sub-sea depths to Dawson Bay surface indicated in feet

Contour Interval = 100 feet (approx. 30 metres)

Contour configuration in S.W. after DeMille et al. (1964)

Well Symbols

- Potash test hole
- Disposal well
- Wildcat well
- Potash shaft hole

Potash mine — approximate extent of mining operations

Structure Contour Map : Top of the Dawson Bay Formation

SCALE

Kilometres 12 0 12 24 36 Kilometres

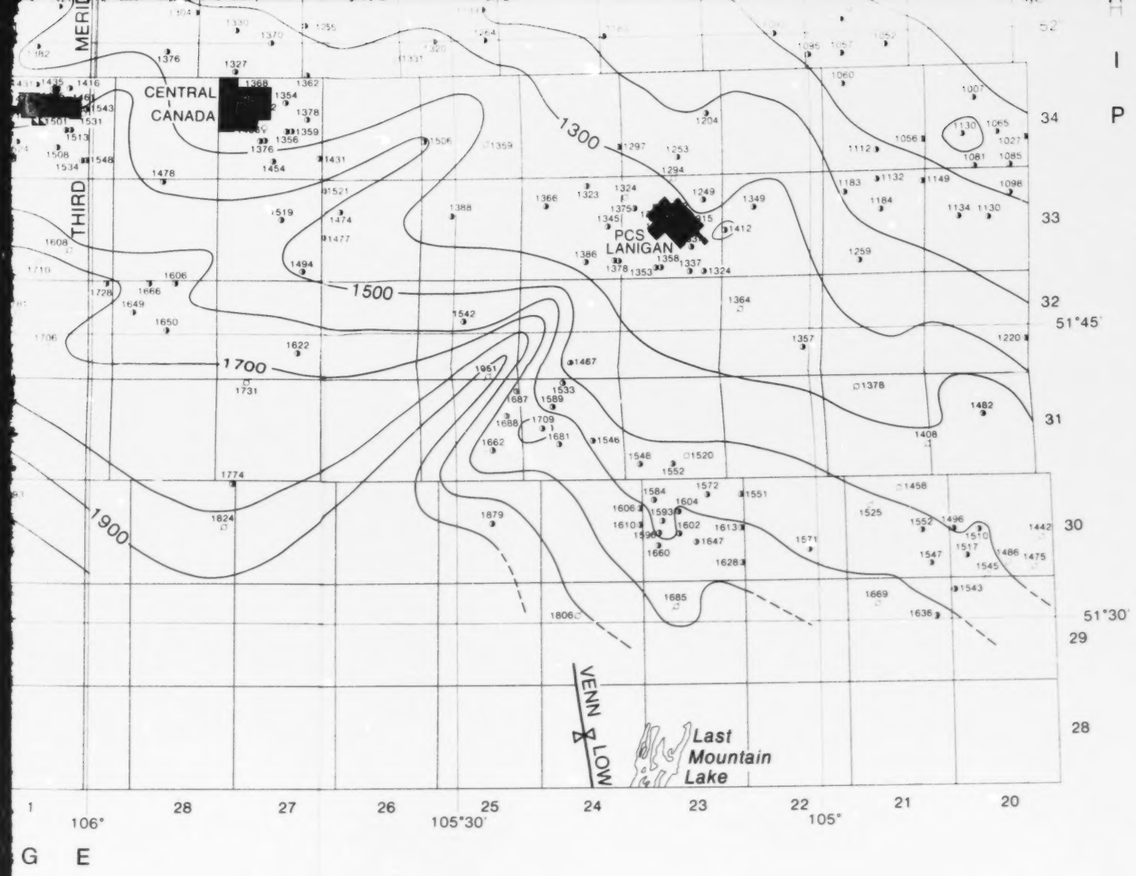
Miles 8 0 8 24 36 Miles

Figure 9

Structur
Top of th

Colin E.
Governm
Departm

Drafting



e Dawson Bay Formation

24 36 Kilometres

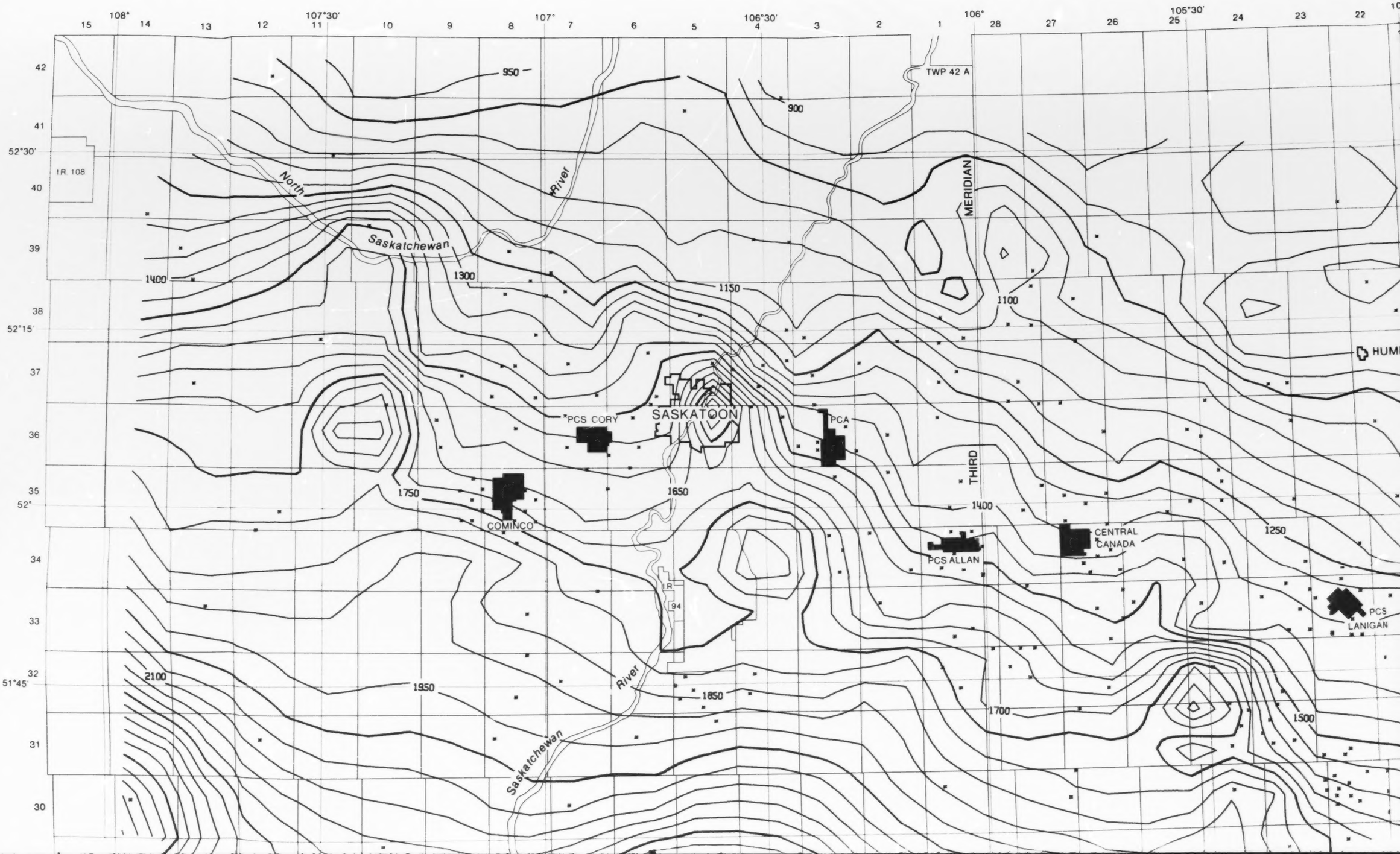
24 36 Miles

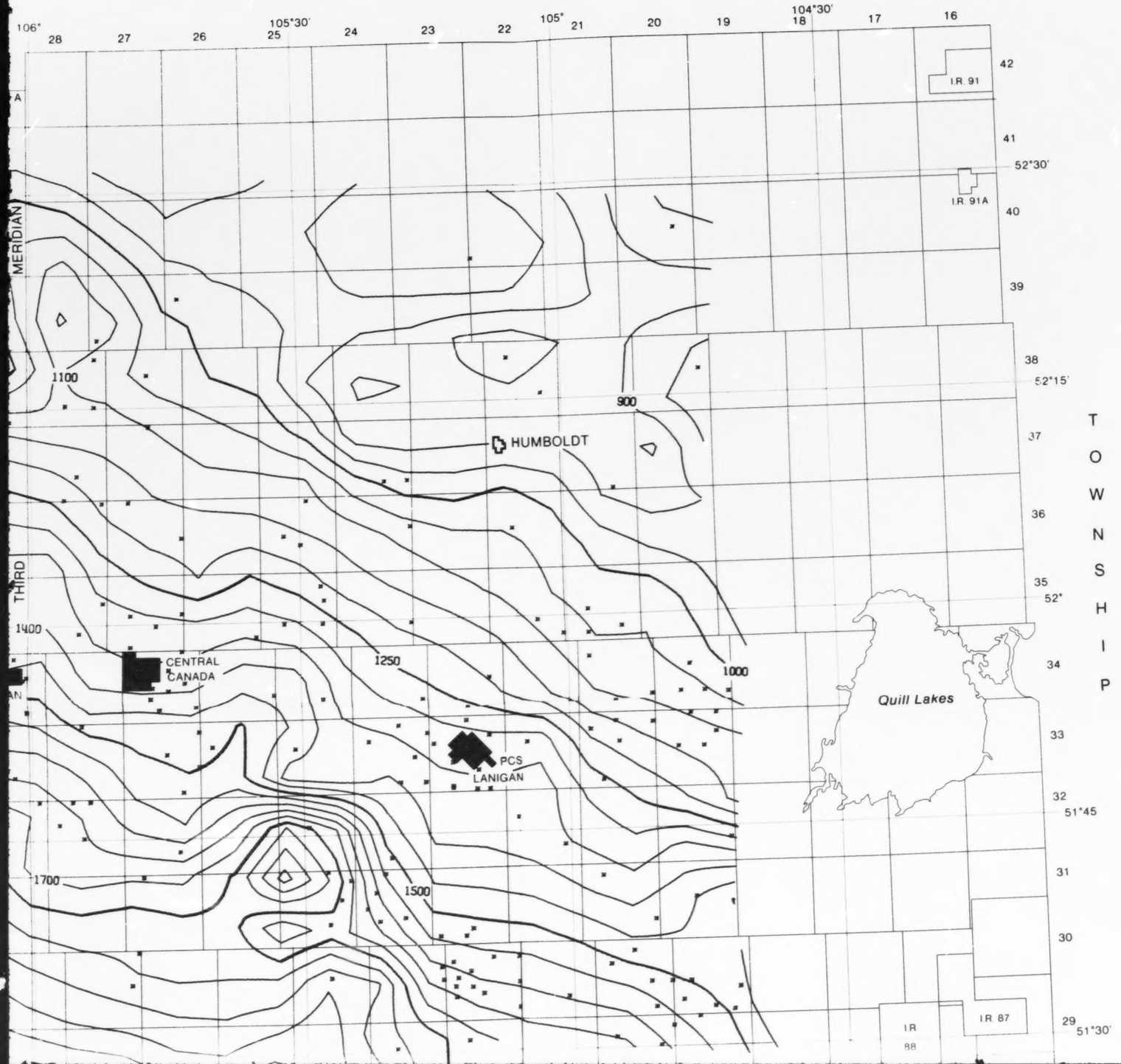
Figure 9

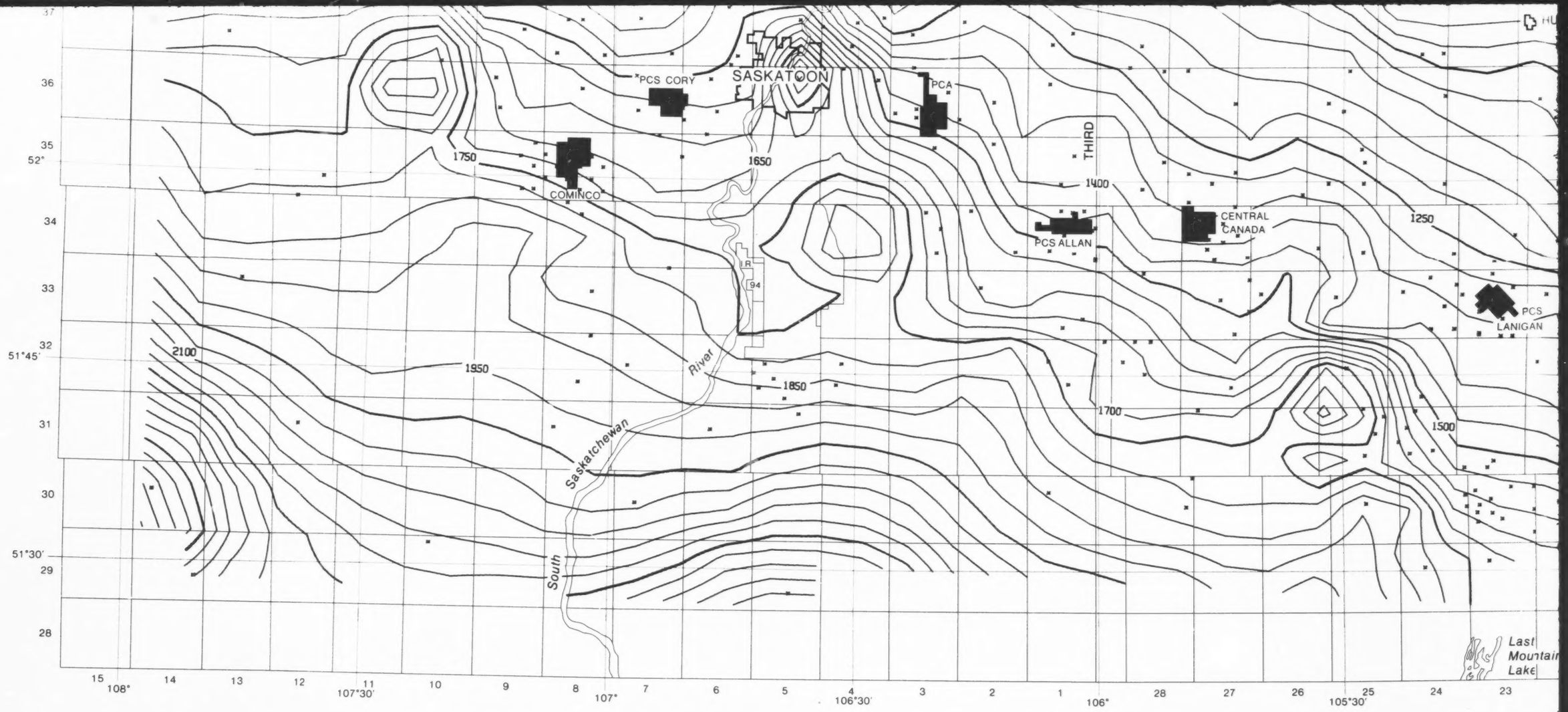
Structure Contour Map:
Top of the Dawson Bay Formation

Colin E. Dunn Report 194
Government of Saskatchewan
Department of Mineral Resources

Drafting by P. A. Weir


108°
107°30'
107°
106°30'
106°
105°30'
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
28
27
26
25
24
23
22
42
41
52°30'
40
39
38
52°15'
37
36
35
52°
34
33
32
51°45'
31
30
950
900
TWP 42 A
IR 108
North
Saskatchewan
River
1400
1300
1150
1100
MERIDIAN
HUM
PCS CORY
SASKATOON
PCA
1750
1650
COMINCO
THIRD
1400
CENTRAL
CANADA
1250
PCS ALLAN
IR
94
PCS
LANIGAN
2100
1950
1850
1700
1500
Saskatchewan
River


106°
28
27
26
105°30'
25
24
23
22
105°
21
20
19
104°30'
18
17
16
42
41
52°30'
40
39
38
52°15'
37
36
35
52°
34
33
32
51°45
31
30
29
51°30'
A
MERIDIAN
THIRD
AN
I.R. 91
I.R. 91A
1100
900
HUMBOLDT
1400
CENTRAL
CANADA
1250
1000
PCS
LANIGAN
1700
1500
Quill Lakes
I.R
88
I.R. 87
T
O
W
N
S
H
I
P



LEGEND

Contour Interval = 50 feet (approx. 15 metres)

Depths are in feet below sea level

▪ Control well

Potash mine — approximate extent of mining operations

Computer-Plotted Structure Contour Map
Top of the Dawson Bay Formation

SCALE

Kilometres 12 0 12 24 36 Kilometres

Miles 8 0 8 24 36 Miles

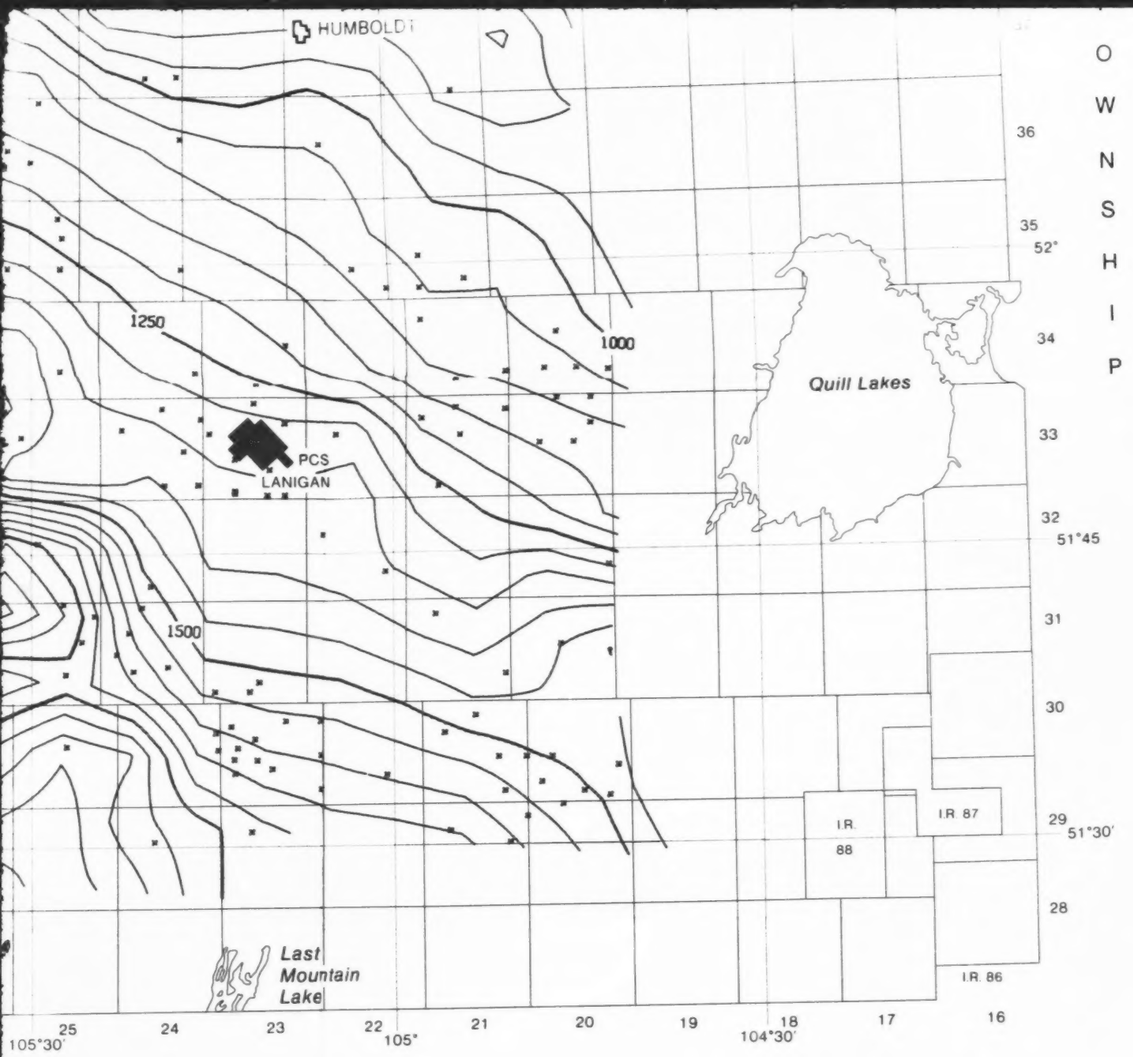
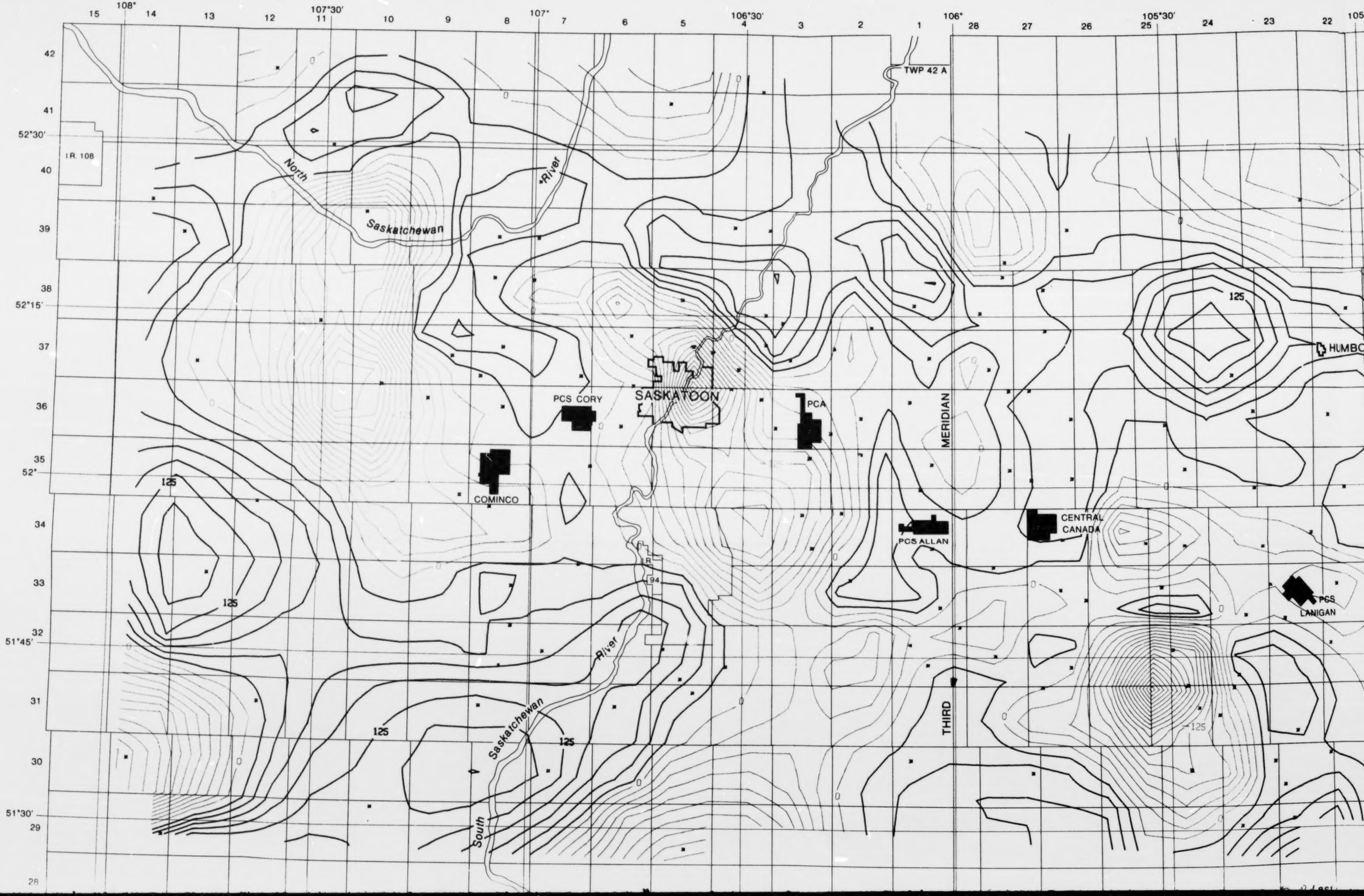


Figure 11

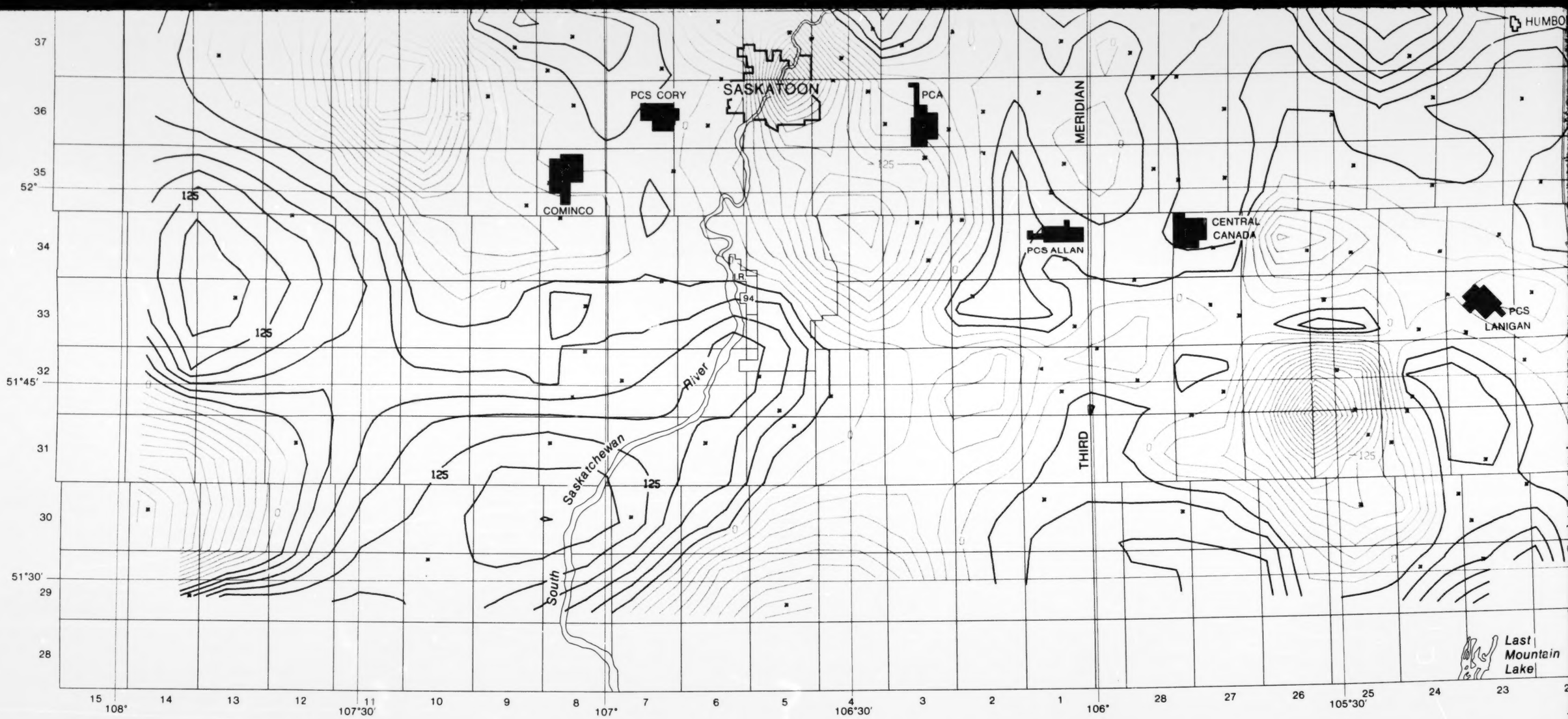
Computer-Plotted
Structure Contour Map
Top of the Dawson Bay Formation

Colin E. Dunn Report 194
Government of Saskatchewan
Department of Mineral Resources

Drafting by P. A. Weir


108°
107°30'
107°
106°30'
106°
105°30'
TWP 42 A
I.R. 108
North Saskatchewan River
PCS CORY
SASKATOON
PCA
MERIDIAN
HUMBO
COMINCO
CENTRAL CANADA
PCS ALLAN
PCS LANIGAN
THIRD
South Saskatchewan River
125
0

106°
105°30′
105°
104°30′
1
28
27
26
25
24
23
22
21
20
19
18
17
16
TWP 42 A
I.R. 91
I.R. 91A
42
41
52°30′
40
39
38
52°15′
37
36
35
52°
34
33
32
51°45′
31
30
29
51°30′
28
125
HUMBOLDT
MERIDIAN
THIRD
CENTRAL CANADA
CS ALLAN
PCS LANIGAN
Quill Lakes
I.R. 87
I.R. 88
T O W N S H I P
Last



LEGEND

Contour Interval = 25 feet (approx. 7.5 metres)

× Control well

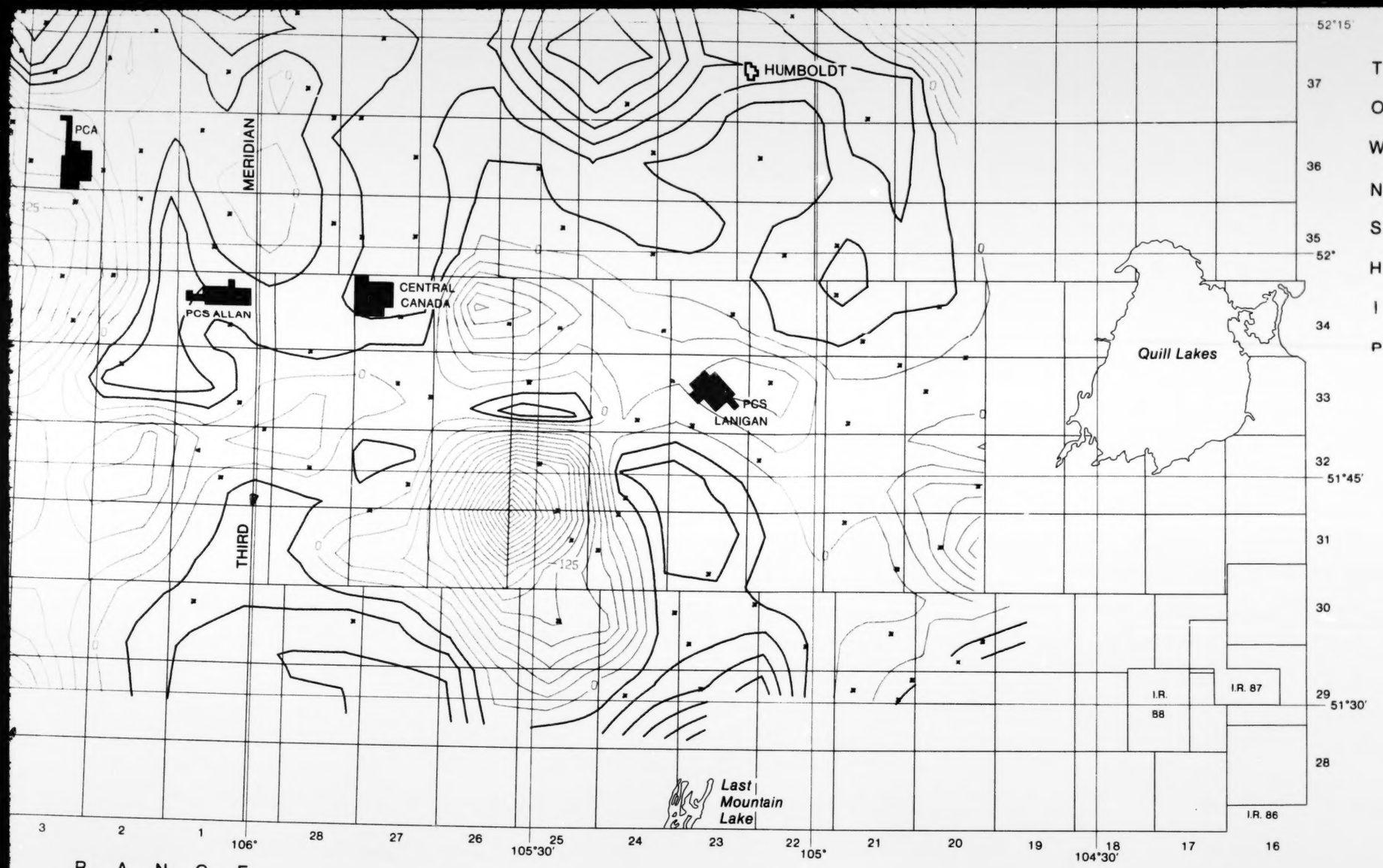
Potash mines — approximate extent of mining operations

Computer-Plotted Third Degree Trend Surface Residuals — Top of the Prairie Evaporite

SCALE

Kilometres 12 0 12 24 36 Kilometres

Miles 8 0 8 24 36 Miles



Third Degree Trend Surface Residuals
op of the Prairie Evaporite

SCALE

0 12 24 36 Kilometres

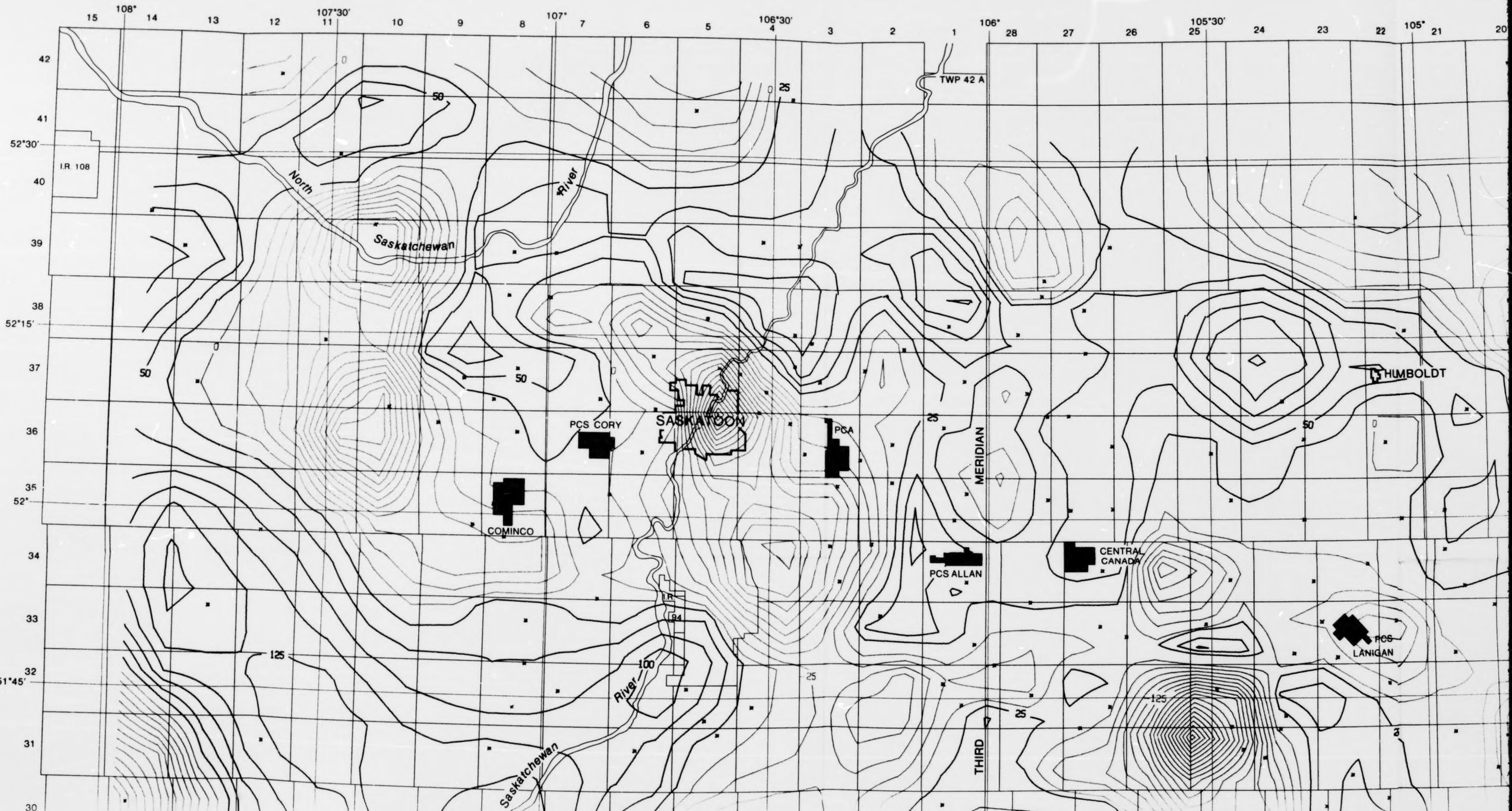
0 8 24 36 Miles

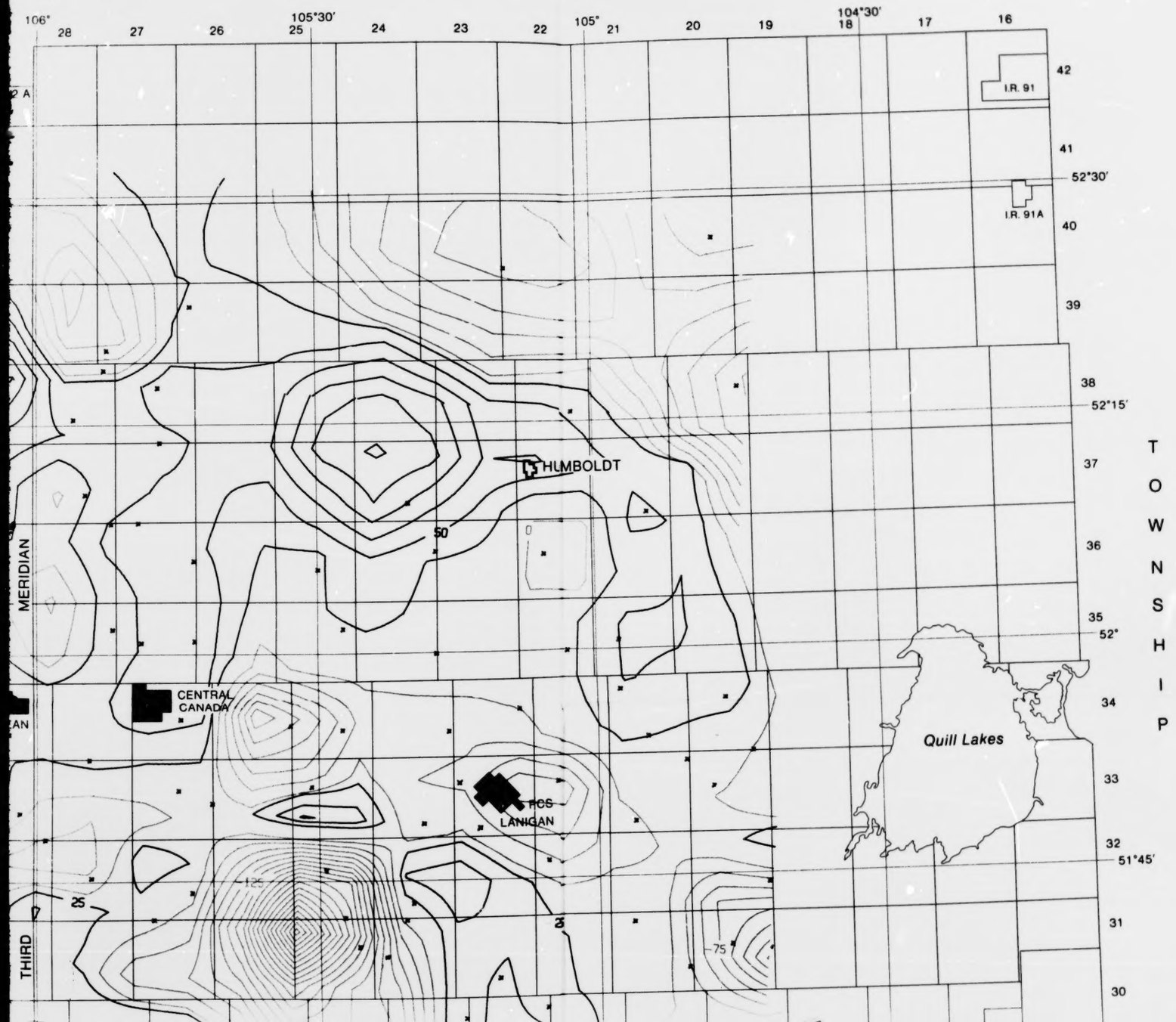
Figure 13

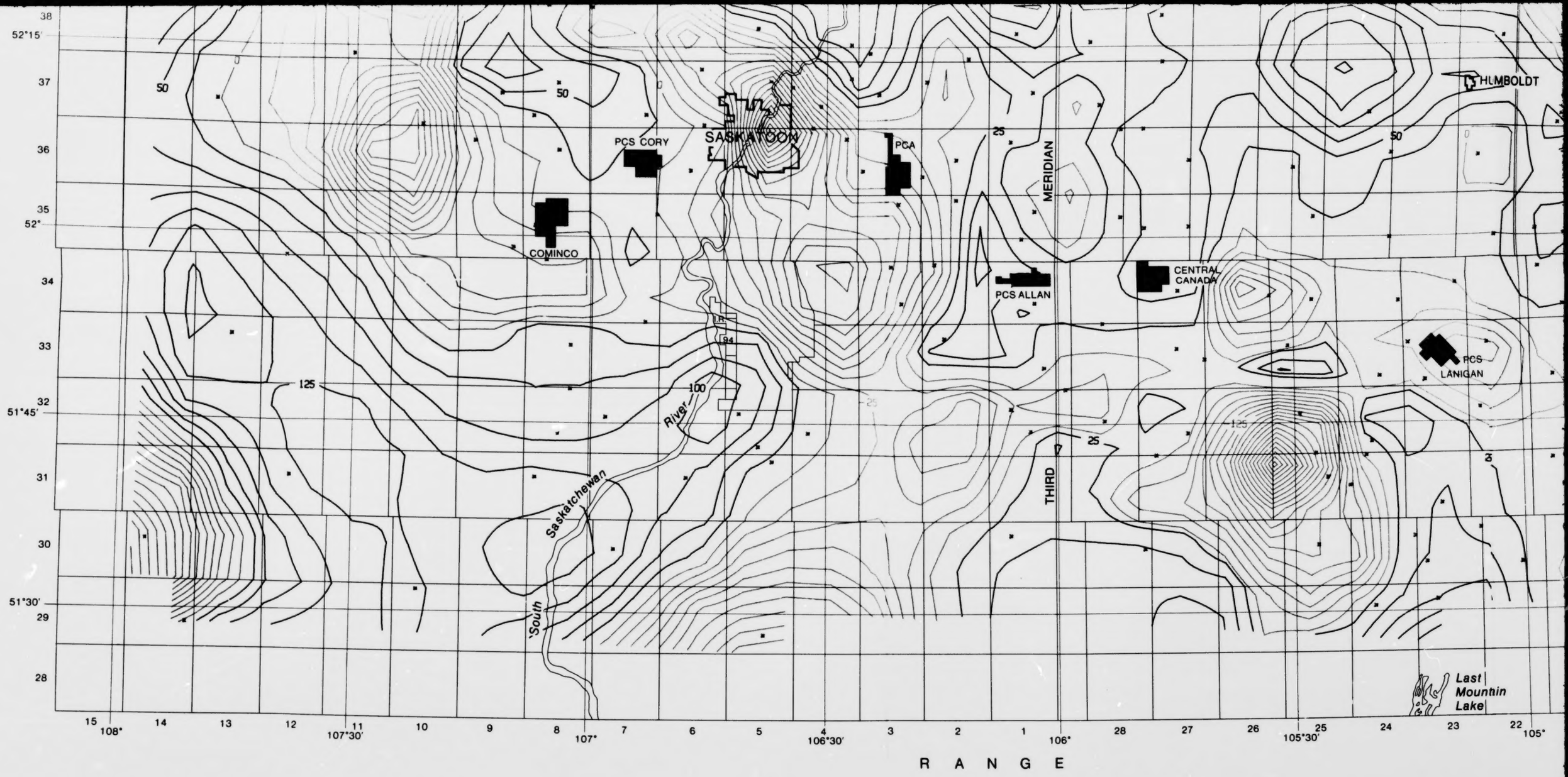
Computer-Plotted
Third Degree Trend Surface Residuals
Top of the Prairie Evaporite

Colin E. Dunn Report 194
Government of Saskatchewan
Department of Mineral Resources

Drafting by P. A. Weir


108°
107°30′
107°
106°30′
106°
105°30′
105°
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
28
27
26
25
24
23
22
21
20
42
41
40
39
38
37
36
35
34
33
32
31
30
52°30′
52°15′
52°
51°45′
TWP 42 A
I.R. 108
North Saskatchewan River
Saskatchewan River
50
25
125
100
0
PCS CORY
SASKATOON
PCA
COMINCO
PCS ALLAN
CENTRAL CANADA
HUMBOLDT
PCS LANIGAN
I.R. 94
MERIDIAN
THIRD


106°
28
27
26
105°30′
25
24
23
22
105°
21
20
19
104°30′
18
17
16
42
41
52°30′
40
39
38
52°15′
37
36
35
52°
34
33
32
51°45′
31
30
I.R. 91
I.R. 91A
HUMBOLDT
CENTRAL CANADA
FCS LANIGAN
Quill Lakes
50
0
25
75
THIRD MERIDIAN
TOWNSHIP



LEGEND

Contour Interval = 25 feet (approx. 7.5 metres)

▪ Control well

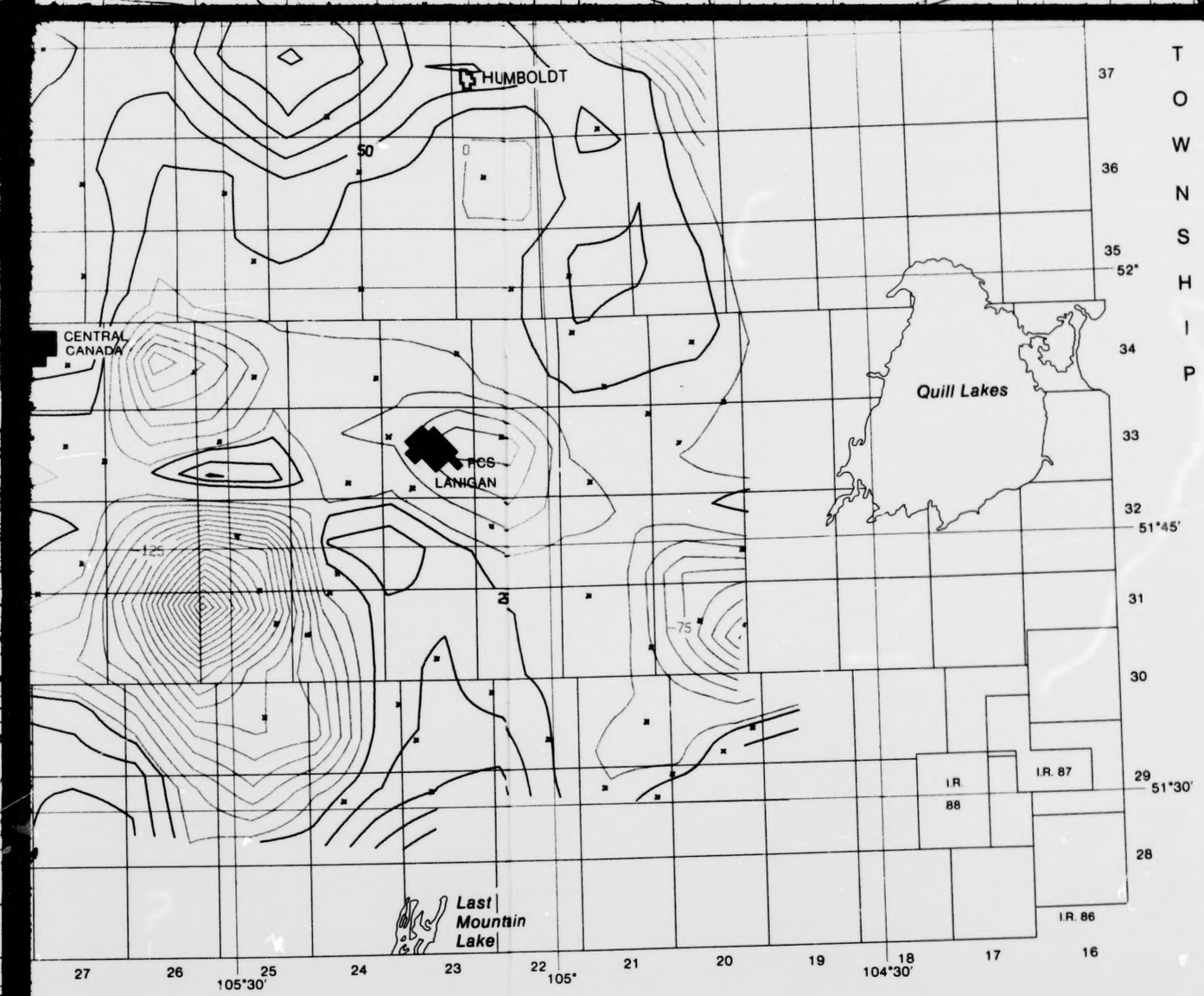
■ Potash mine — approximate extent of mining operations

Computer-Plotted Third Degree Trend Surface Residuals — Top of the Dawson Bay Formation

SCALE

Kilometres 12 0 12 24 36 Kilometres

Miles 8 0 8 16 24 Miles



face Residuals
tion

6 Kilometres

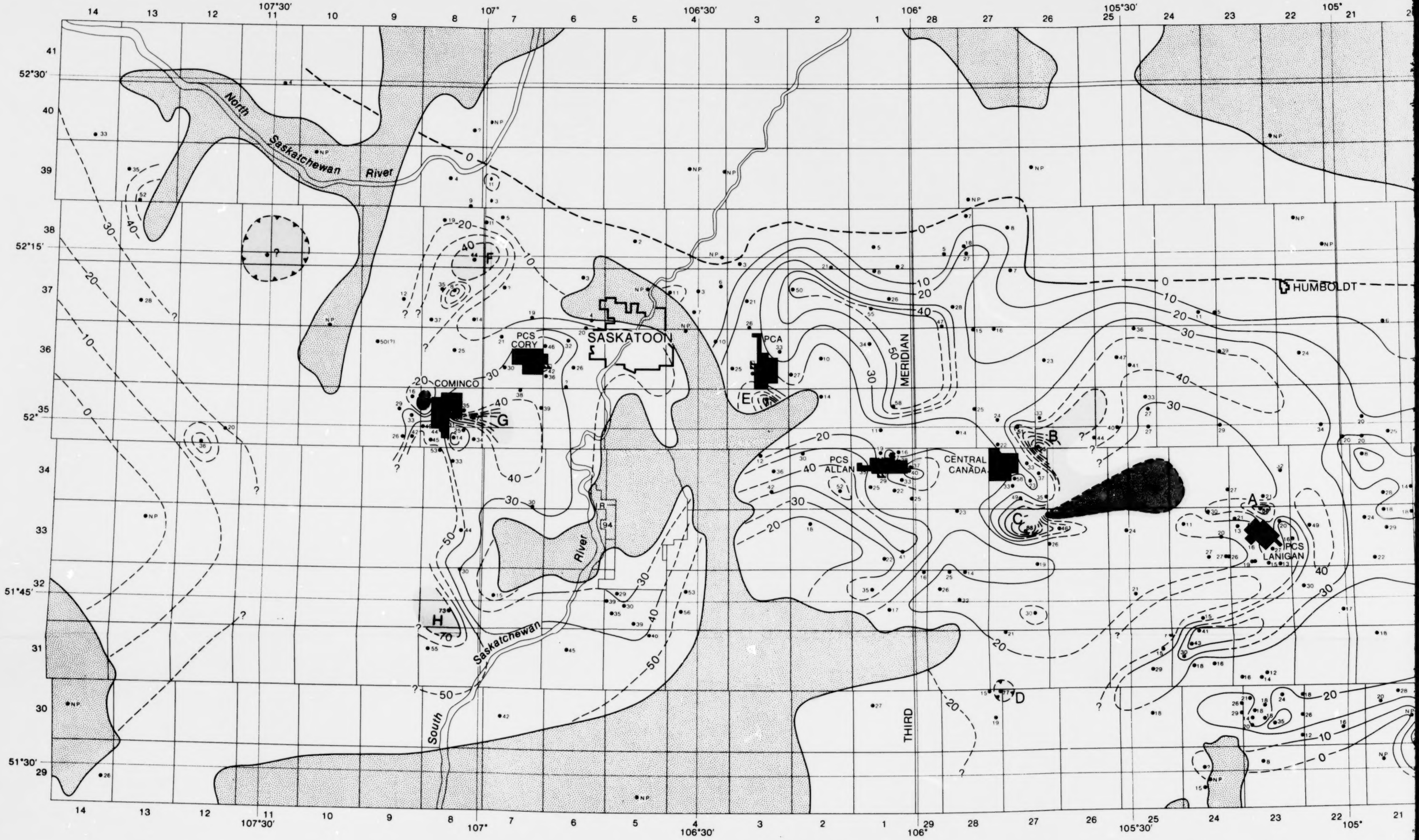
24 Miles

Figure 12

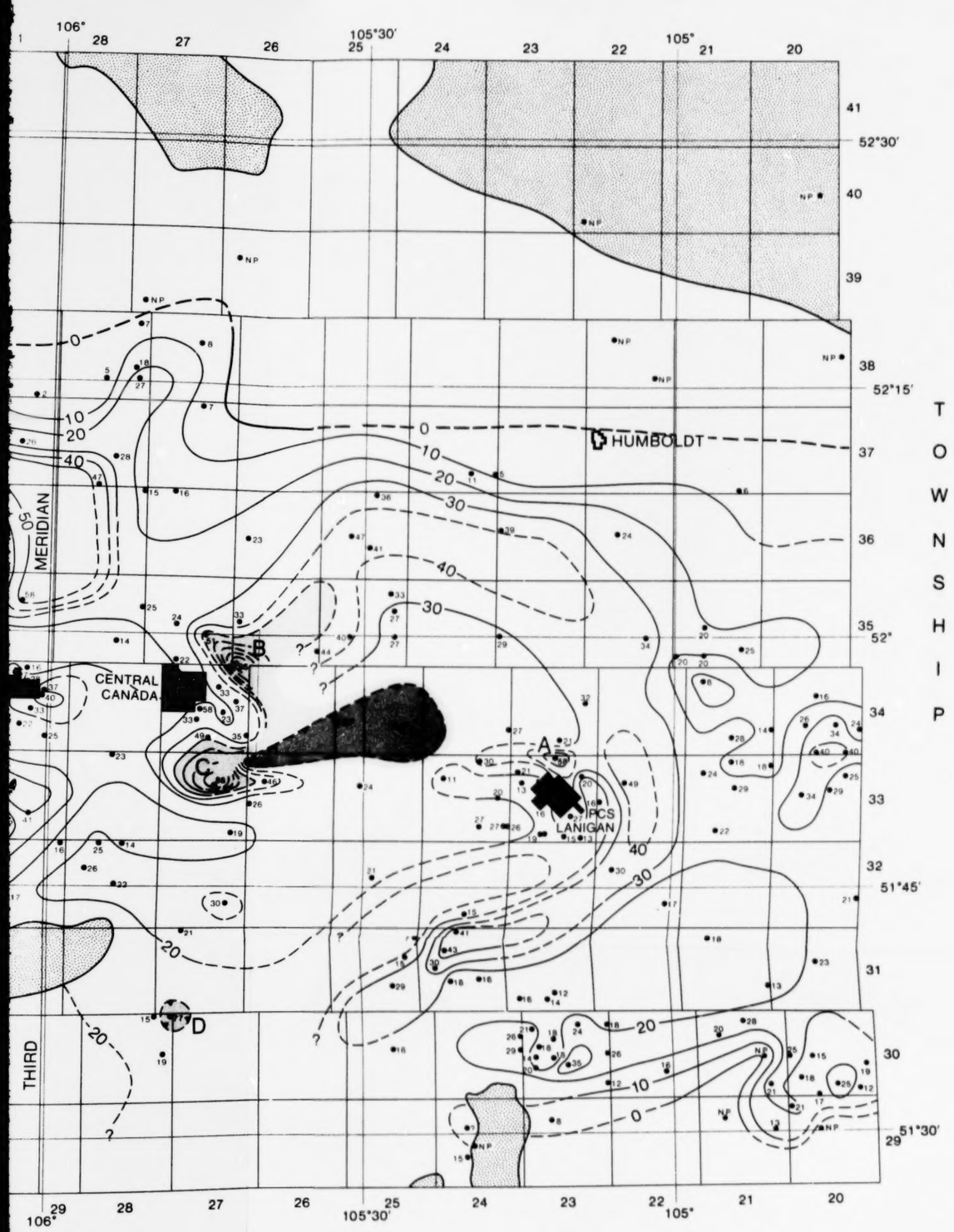
Computer-Plotted
Third Degree Trend Surface Residuals —
Top of the Dawson Bay Formation

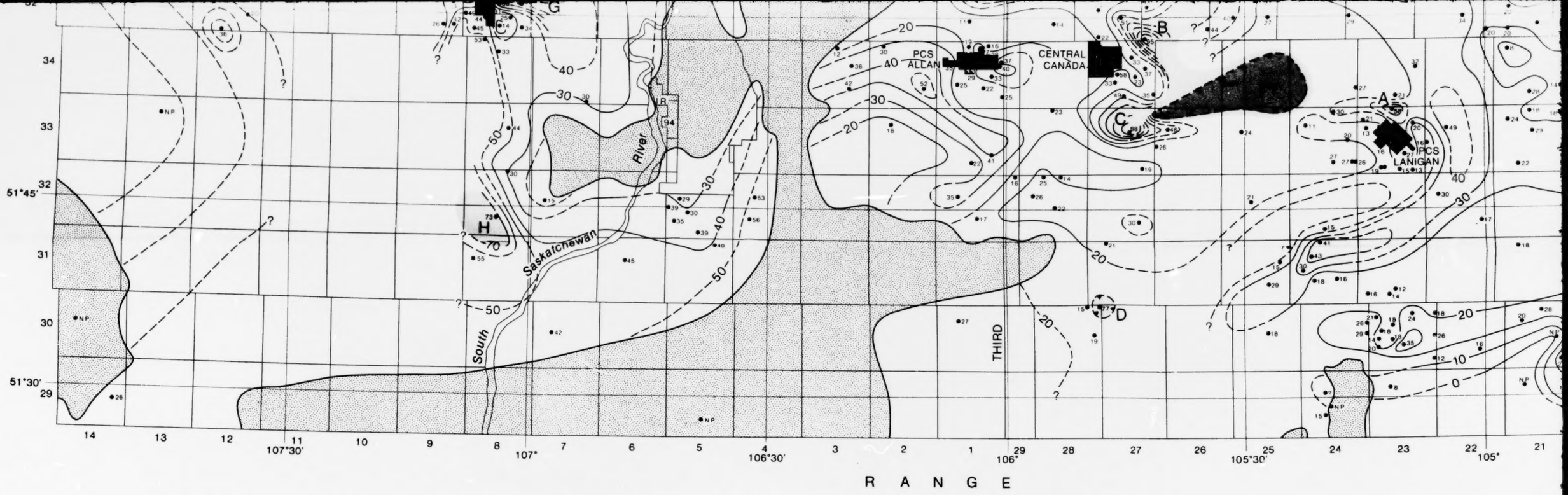
Colin E. Dunn Report 194
Government of Saskatchewan
Department of Mineral Resources

Drafting by P. A. Weir


North Saskatchewan River
SASKATOON
HUMBOLDT
PCS CORY
COMINCO
PCA
PCS ALLAN
CENTRAL CANADA
PCS LANIGAN
South Saskatchewan River
50 MERIDIAN
THIRD
A
B
C
D
E
F
G
H
107°30'
107°
106°30'
106°
105°30'
105°
52°30'
52°15'
52°
51°45'
51°30'
RANGE

LEGEND


106°
105°30'
105°
28
27
26
25
24
23
22
21
20
41
40
39
38
37
36
35
34
33
32
31
30
29
52°30'
52°15'
52°
51°45'
51°30'
T
O
W
N
S
H
I
P
HUMBOLDT
CENTRAL CANADA
PCS LANIGAN
A
B
C
D
0
10
20
30
40
50
MERIDIAN
THIRD
NP
E



LEGEND

Contour Interval = 10 feet (approx. 3 metres)

Areas where potash of the Patience Lake Member is absent

Areas where some potash beds of the Patience Lake Member are absent

Areas of major salt-solutioning modified after M. A. Fuzesy (pers. comm.)

A - H Sites of relatively thick halite, referred to in text

Erosional Edge of Patience Lake Member of the Prairie Evaporite

NP Patience Lake Member is absent (i.e. — no KCl) — either due to erosion, solution or non-deposition.

Potash mine — approximate extent of mining operations

Halite Isopach Between the Base of the Second Red Bed Member and the Top of the Patience Lake Potash Beds

SCALE

Kilometres 12 0 12 24 36 Kilometres

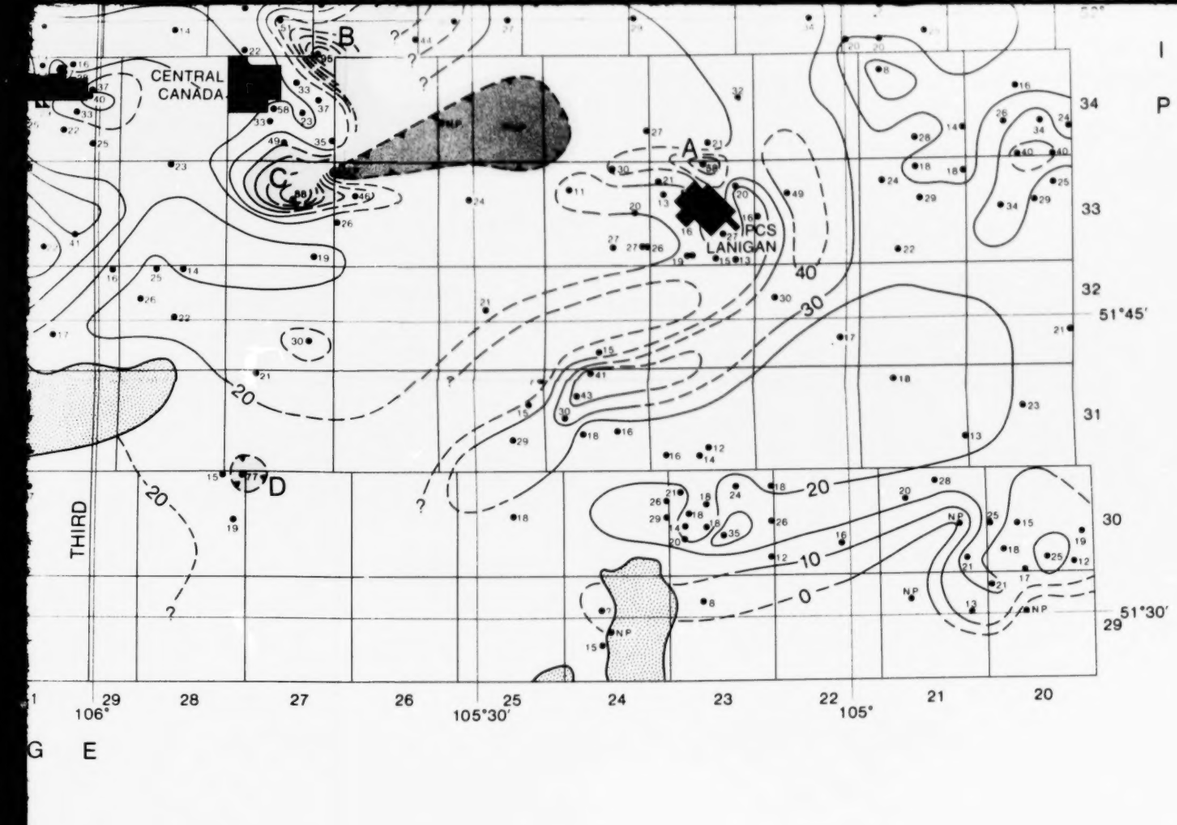
Miles 8 0 8 16 24 Miles

Figure 14

Halite Isopach Betwe
Base of the Second R
and the Top of the
Patience Lake Potash

Colin E. Dunn Rep
Government of Saska
Department of Minera

Drafting by P. A. Weir



of the Second Red Bed
nce Lake Potash Beds

24 36 Kilometres

16 24 Miles

Figure 14

Halite Isopach Between the
Base of the Second Red Bed Member
and the Top of the
Patience Lake Potash Beds

Colin E. Dunn Report 194
Government of Saskatchewan
Department of Mineral Resources

Drafting by P. A. Weir

5 km
3 mi.

10 km
6 mi.

A

B

C

G.R.

N.

ft.

m

3500

1070

3550

1080

3600

1090

3650

1100

1110

3700

1120

8

7

6

5

4

3

2

1

SHALE

TIME – EQUIVALENT TOP TO
PATIENCE LAKE MEMBER

MISSING
POTASH
BEDS

LITHOSTRATIGRAPHIC TOP TO PATIENCE
LAKE MEMBER

BED 8 MISSING

7a

3400

1040

3450

1050

1060

3500

1070

1080

1090

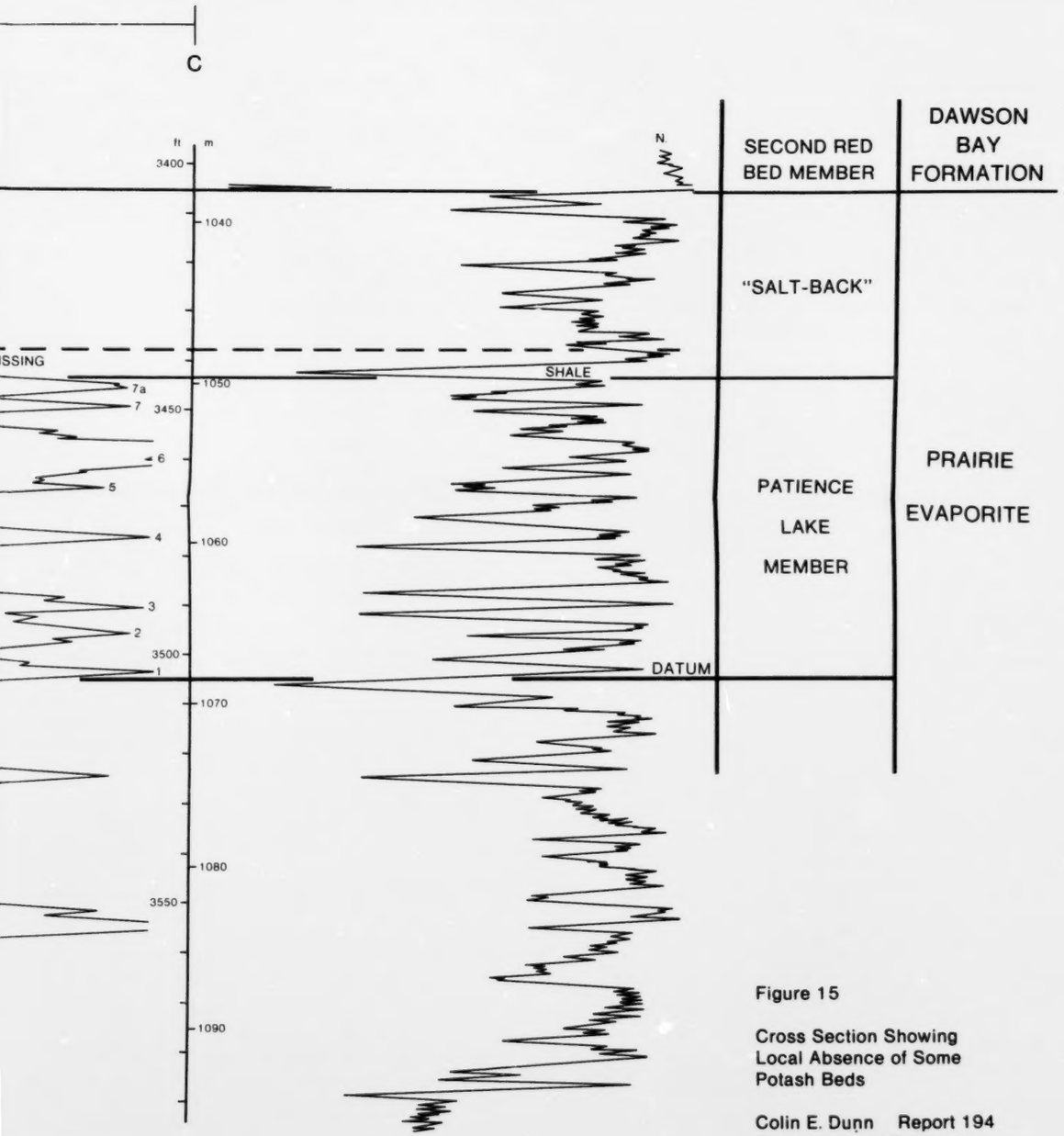
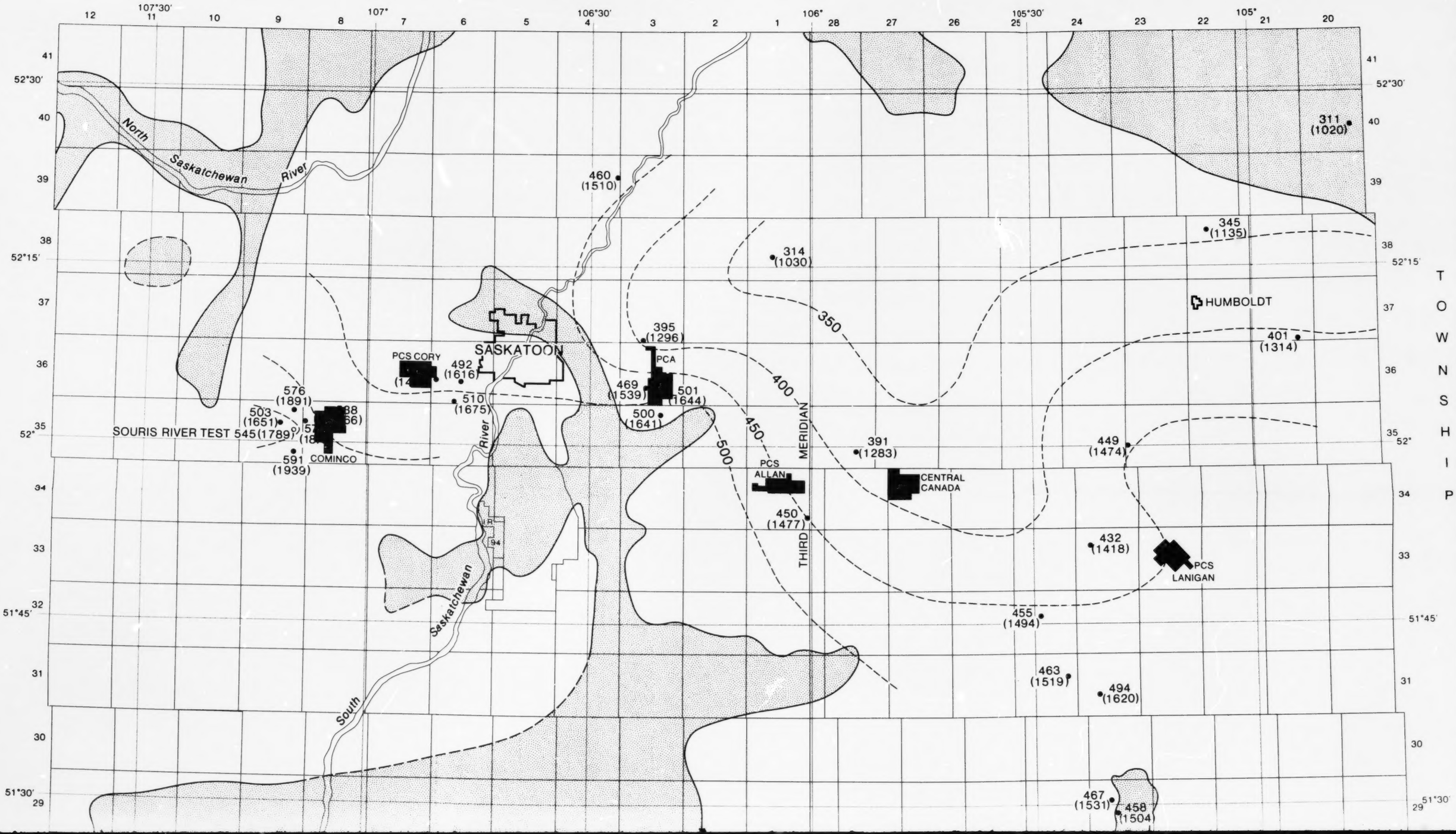


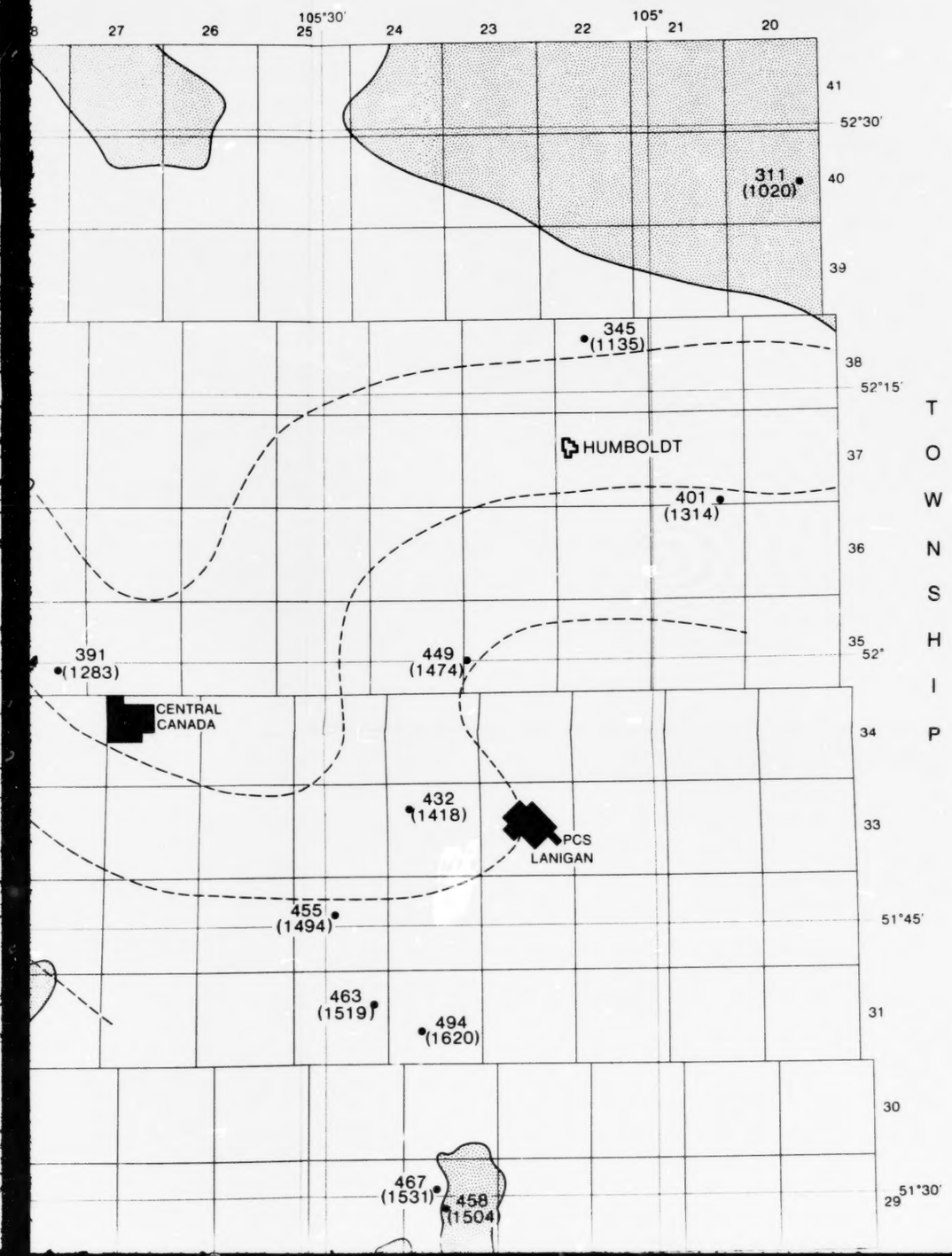
Figure 15

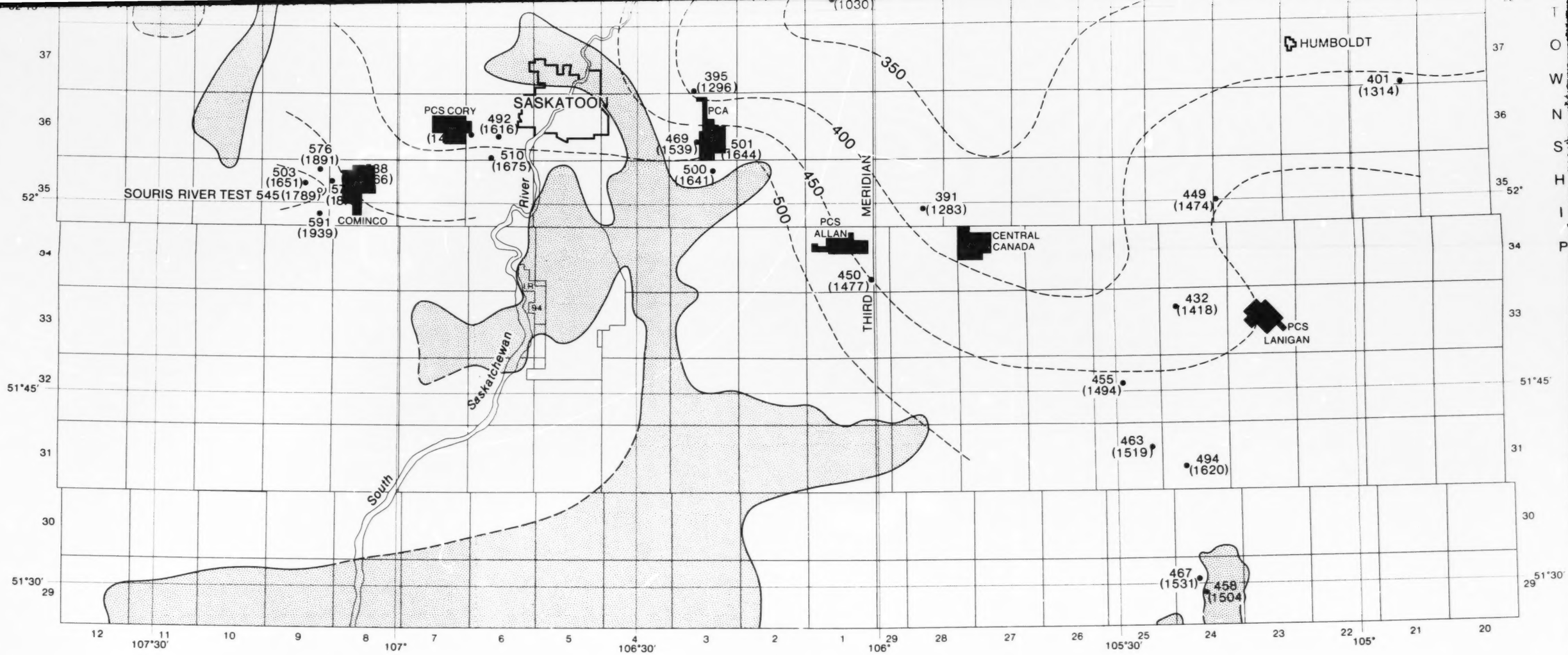
Cross Section Showing
Local Absence of Some
Potash Beds

Colin E. Dunn Report 194
Government of Saskatchewan
Department of Mineral Resources

Drafting by Grant Chow


107°30'
107°
106°30'
106°
105°30'
105°
52°30'
52°15'
52°
51°45'
51°30'
North Saskatchewan River
South Saskatchewan River
SASKATOON
HUMBOLDT
PCS CORY
PCA
COMINCO
PCS ALLAN
CENTRAL CANADA
PCS LANIGAN
SOURIS RIVER TEST 545(1789)
460 (1510)
311 (1020)
345 (1135)
314 (1030)
395 (1296)
401 (1314)
492 (1616)
469 (1539)
501 (1644)
510 (1675)
500 (1641)
576 (1891)
503 (1651)
591 (1939)
391 (1283)
449 (1474)
450 (1477)
432 (1418)
455 (1494)
463 (1519)
494 (1620)
467 (1531)
458 (1504)
350
400
450
500
THIRD MERIDIAN
IR 94
TOWNSHIP


105°30'
105°
28
27
26
25
24
23
22
21
20
41
52°30'
311
(1020)
40
39
345
(1135)
38
52°15'
HUMBOLDT
37
401
(1314)
36
391
(1283)
449
(1474)
35
52°
CENTRAL
CANADA
34
432
(1418)
33
PCS
LANIGAN
455
(1494)
51°45'
463
(1519)
494
(1620)
31
30
467
(1531)
458
(1504)
29
51°30'
T
O
W
N
S
H
I
P



LEGEND

Contour Interval = 50 metres (approx. 165 feet)

Areas of Prairie Evaporite erosion or salt-solutioning (after M. A. Fuzesy, pers. comm.)

• Control wells — values indicate potentiometric surface in metres (feet in parenthesis) above sea level

Potash mines — approximate extent of mining operations

Potentiometric Surface — Dawson Bay Formation

SCALE

Kilometres 12 0 12 24 36 Kilometres

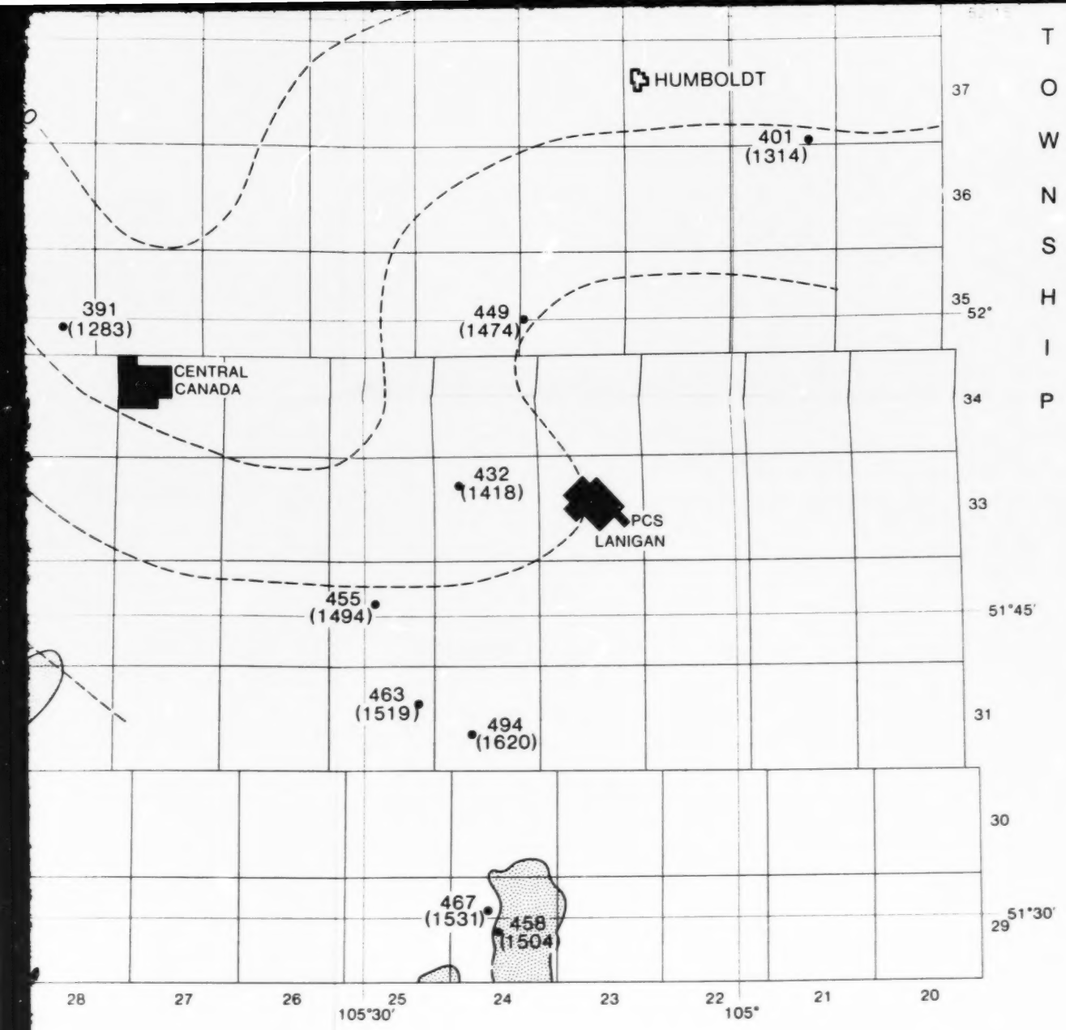
Miles 8 0 8 16 24 Miles

Figure 17

Potentiometric Surface — Dawson Bay Formation

Colin E. Dunn Report 194
Government of Saskatchewan
Department of Mineral Resources

Drafting by P. A. Weir



wson Bay Formation

24 36 Kilometres

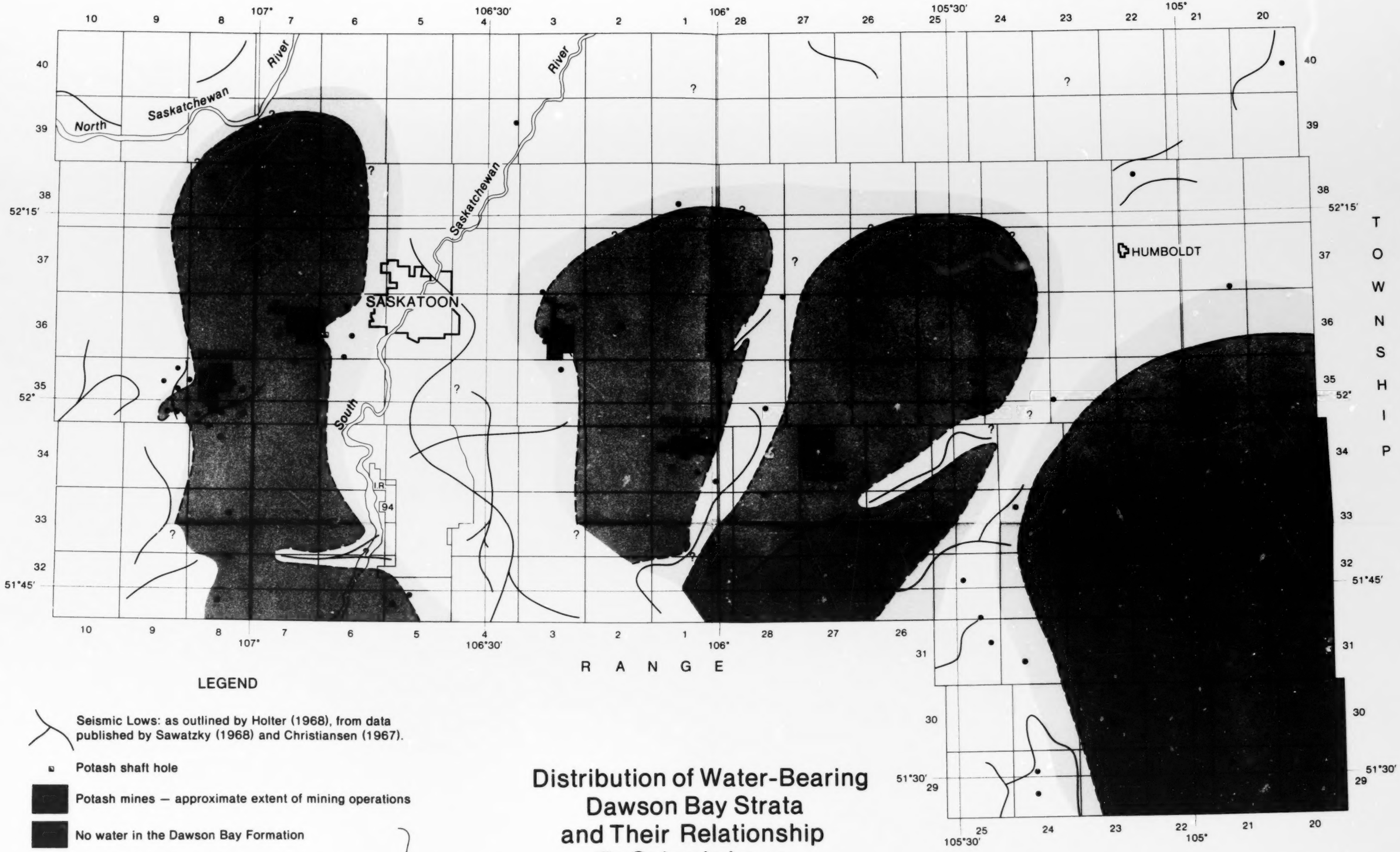
16 24 Miles

Figure 17

Potentiometric Surface —
Dawson Bay Formation

Colin E. Dunn Report 194
Government of Saskatchewan
Department of Mineral Resources

Drafting by P. A. Weir



LEGEND

Seismic Lows: as outlined by Holter (1968), from data published by Sawatzky (1968) and Christiansen (1967).

Potash shaft hole

Potash mines — approximate extent of mining operations

No water in the Dawson Bay Formation

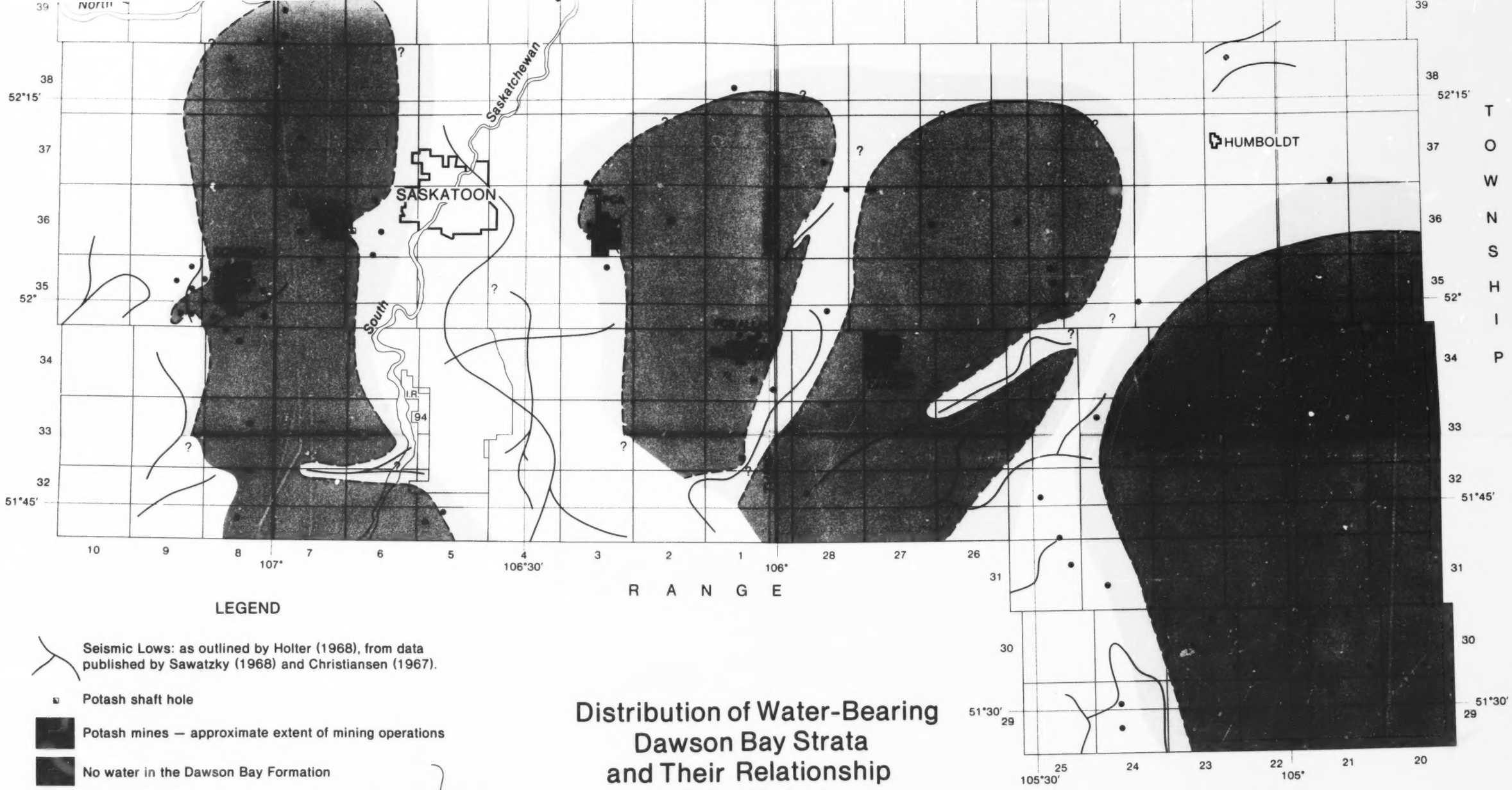
No water in lower half of the Dawson Bay Formation (Second Red Bed and Burr Members)

Water throughout the Dawson Bay Formation

Proven or Inferred

Distribution of Water-Bearing Dawson Bay Strata and Their Relationship To Seismic Lows

Figure 16



LEGEND

Seismic Lows: as outlined by Holter (1968), from data published by Sawatzky (1968) and Christiansen (1967).

Potash shaft hole

Potash mines — approximate extent of mining operations

No water in the Dawson Bay Formation

No water in lower half of the Dawson Bay Formation (Second Red Bed and Burr Members)

Water throughout the Dawson Bay Formation

Proven or Inferred

Wells from which drill-stem-tests were made in the Dawson Bay Formation

N.B. This map is based entirely on drill-stem-test data. Consideration has not been given to well logs which indicate probable plugging of porosity by halite

Distribution of Water-Bearing Dawson Bay Strata and Their Relationship To Seismic Lows

SCALE

Kilometres 12 0 12 24 36 Kilometres

Miles 8 0 8 16 24 Miles

Figure 16

Distribution of Water-Bearing Dawson Bay Strata and Their Relationship to Seismic Lows

Colin E. Dunn Report 194
Government of Saskatchewan
Department of Mineral Resources

Drafting by P. A. Weir